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FORECASTING MODELS FOR AIR FREIGHT DEMAND AND PROJECTION OF CARGO ACTIVITY AT U.S. AIR HUBS JANUARY 1977

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
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16. Abstract

This report provides a basic forecast of U.S. domestic and U.S. international air freight demand at the twenty-five large U.S. hubs for the time period 1977 to 1987 which results from exercising the models described in this report with a specific set of input variable projections.

This report also documents an econometric model approach to long-term, national air freight demand forecasting. This approach provides forecasts founded on the premise that no dramatic technological or socio/political changes will occur in the forecast time period.

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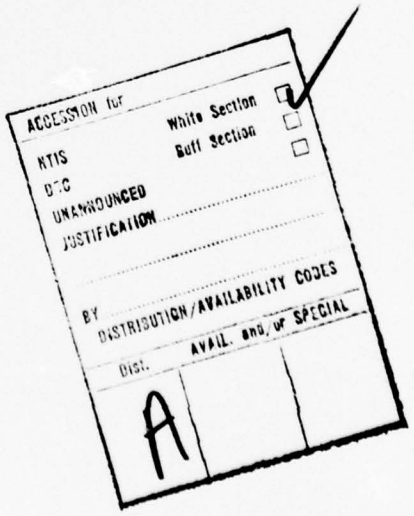

Report No. SS-211-U1-4

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PROJECTION OF CARGO ACTIVITY AT U. S. AIR HUBS

BY

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TECHNICAL SUMMARY

This paper documents a method for projection of air cargo activity (i.e., enplanements and freighter operations) at all U.S. air hub airports. It also provides a base projection of such activity at twenty-five large hubs for 1977, 1982 and 1987 based on a specific set of inputs developed jointly by TSC and the FAA sponsor. The projection computer model translates a national aggregate cargo enplanement forecast and a set of hub passenger enplanement forecasts into hub specific enplanements in passenger flight lower holds, enplanements in freighters, and into freighter operations. The national aggregate cargo enplanement forecast was developed as a part of this project and is documented in a companion paper, "Forecasting Models and Forecasts of U.S. Domestic and U.S. International Air Freight Demand," by D. Maio and G. Wang, September 1976, SS-211-U1-5. The passenger enplanements and other required inputs were developed from sources documented in this paper. The computer program is documented in a Kentron Hawaii, Limited paper, "Freighter Forecast Model," by R. H. Wassmuth, September 15, 1974, KHL-TSC-74-1180.

This project was conducted by TSC for the FAA Office of Aviation Policy, AVP-120 to support that office's periodic update of Aviation Forecasts and Terminal Area Forecasts.

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SECTION 1

INTRODUCTION

This report documents a method for projection of air cargo activity (i.e., tons enplaned and freighter operations) at all U.S. air hub airports. Cargo related ground and air activity at airports is a result of a derived demand for services. This individual hub activity is generated by the national aggregate demand for commodity distribution. No single air hub can expect significantly greater than average system growth unless it is paired off, in this growth, with other hubs or that hub is the beneficiary of a planned diversion of traffic. Relative prices and relative quality of services offered by each of the competing modes determines the quantity of goods shipped by air in the various markets. Air carriers cannot continue to reduce the real average price differential between air and surface services unless they can sustain a continued reduction in average costs of providing the service. Substantially lower air carrier operating costs and increased capacity are provided by the wide-body passenger fleet. Narrow body freighters (all-cargo) have higher total operating costs and have been reported as being unprofitable. Wide-body freighters are steadily penetrating the international markets, but only minor activity is projected for this type of equipment in domestic service.

Combination passenger/cargo carriers dominate both the domestic and international markets. This group of carriers (who enjoy over 85 percent of the domestic market and over 63 percent of the international market) has been emphasizing the cargo capability of their scheduled wide-body passenger fleets since this equipment was first introduced. Cargo service provided by these carriers is the product of the fleet equipment mix, route assignments, and flight scheduling, which in turn are dictated by passenger service requirements. Freighter services are provided only in

markets served by the all-cargo carriers and in those markets where the combination carriers are unable to adequately service the cargo demand with the passenger fleet. It is projected that the air carrier industry will be economically motivated to continue, during the next ten years, the current policy of maximizing to the greatest extent possible the use of available capacity in the passenger fleet lower holds.

The air cargo hub activity projection computer program accepts as input several exogenous files of historical data and forecasts. It produces projections of passenger flight departures, enplaned tonnage in lower holds, freighter flight departures, and enplaned freighter tonnage at each hub of interest. The required inputs are: (1) CAB Airline Service Segment data tapes for some base period; (2) a passenger enplanement forecast for each hub of interest for each of three forecast years; (3) a cargo enplanement forecast for each hub for the three forecast years; (4) a set of projections of system average passenger and freighter flight capacity measures; (5) a set of system average enplanement load factors for passenger decks, for lower holds, and for freighters. Separate values for the domestic and international services for all but the first inputs are required by the model.

Projections are produced for domestic services and for U.S. international services for each of the three forecast years for each air hub specified. An aggregate projection for the listed hubs is also provided. Any number of hubs may be included in the forecast, but only 25 large hubs have been included in the current base forecast. A set of forty-three tables of data from intermediate calculations are also produced for detailed analysis and evaluation of the final forecasts. Included in these tables are actual operating statistics developed from the airline service segment data for the base period.

SECTION 2

HUB PROJECTION METHODOLOGY

Long term, macro, national air freight (including express), and air mail demand forecasts can be translated into cargo enplanement and freighter operations projections at specific U.S. air hubs. This allocation of national demand can be performed for each cargo element (i.e., freight, express and mail) and for each service - domestic and international. Four major steps are involved in this projection procedure:

a. Allocation of the national demand for cargo tonnage enplaned by hub.

b. Estimation of the passenger fleet "usable"* lower hold capacity by hub.

c. Allocation of the hub demand to the "usable" lower hold capacity and determination of residual demand to be satisfied by freighter service.

d. Translation of this residual demand into hub freighter departures.

The aggregate national cargo demand, expressed in tons enplaned at U.S. airports, is derived from an exogenous forecasting procedure documented in another TSC staff study paper.** Briefly, econometric models forecast domestic revenue ton-miles (RTMs) which were subsequently converted to enplaned tons using projected average hauls. International enplanements at U.S. airports were forecast directly by the model equations. Freight and express demand were forecast in the aggregate using TSC developed models, but mail forecasts were obtained from another source. The details of these forecasts are contained in the referenced paper. Table 1 lists the

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* That portion of the theoretical total passenger fleet lower hold capacity departing each hub which is assigned for use by that hub. This term takes into account capacity that is assigned to upstream or downstream points or is not in the cargo route.

** "Forecasting Models and Forecasts of U.S. Domestic and U.S. International Air Freight Demand" by D. J. Maio and G. Wang, September 1976, SS-211-U1-5.

Table 1. Macro Cargo Forecast Inputs for Base Projections of Cargo Activity at U.S. Air Hubs.

	1977 (000)	1982 (000)	1987 (000)
U.S. Domestic Air Cargo Enplanements			
Freight and Express (tons)	2976	3861	5014
Mail (tons)	963	974	1043
Cargo (tons)	3939	4835	6057
U.S. - International Air Cargo Enplanements (Exports)			
Freight and Express (tons)	993	1524	2282
Mail (tons)	126	135	150
Cargo (tons)	1119	1659	2432

Source: "Forecasting Models and Forecasts of U.S. Domestic and U.S. International Air Freight Demand," TSC staff study by D. Maio and G. Wang, September 1976, SS-211-U1-5.

macro cargo forecasts which are the primary cargo demand inputs to this projection procedure. Freight (including express) and mail for the domestic services and for the international flows in and out of U.S. airports are listed separately.

Subsection 2.1 discusses the procedure for allocation of these macro, national demands to air hubs in proportion to their respective shares of the total. These shares are inputs and may be derived from recent airport activity statistics or from independent analyses generating scenarios which project significant changes in

percentage shares among the hubs. Subsection 2.2 details the procedure for estimating the lower hold capacity. The cargo markets served from each hub are analyzed by the computer program to develop measures of fleet mix, equipment capacity, capacity utilization unique to each hub, and the coincidence of lower hold capacity with the cargo demand on each route.* The projected lower hold usable capacity at each hub is developed by first translating the latest FAA hub passenger enplanement forecasts into required available seats and subsequently into tonnage capacity, using projected values of the carrier operating parameters.

Subsection 2.3 covers the procedure for allocating the projected cargo enplanement tonnage to the usable lower hold capacity at each hub on the basis of hub unique enplanement load factors whose trends reflect that of the system-wide enplanement load factor which is an input. The residual cargo demand can then be allocated to freighter flights.

Subsection 2.4 details the translation of this residual enplaned cargo tonnage at each hub into freighter departures in accordance with estimates of equipment size and enplanement load factors for freighters. System-wide estimates of these two parameters are inputs which the model translates into hub unique values. As in the case of the lower hold capacity, the computer analysis of past operations of freighters using the service segment data is also a basic input to this portion of the procedure.

This procedure gives consideration to the latest carrier operating strategies. Such factors as equipment assignment, routing and scheduling practices and local

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* This computerized analysis of the key system operating parameters is based on the latest available CAB Airline Service Segment Data Tapes (one month, one quarter, or one year's aggregate data). The twelve months ending March 1975 constituted the latest available tapes for this project and form the basis for projections in this report.

enplanements which result from the relative position of hubs and routes in the overall air network are accounted for by a series of direct and indirect measures of hub unique capacity and capacity utilization. Multiple stop service with passenger flights and freighters has been a common practice for providing frequent service to many points unable to support frequent direct service by large aircraft. This procedure gives consideration to the fact that some portion of the theoretical capacity departing from a hub is committed to upstream and downstream points and is thus unavailable to the local demand.

The approach, as outlined above and detailed in the subsequent subsections, has been followed in developing the FAA/TSC base projection of cargo tonnage enplanements and freighter departures presented in Section 3 of this paper.

2.1 PROJECTION OF ENPLANED CARGO TONS BY HUB

Aggregate, national forecast of enplanement tons, such as shown on Table 1, can be allocated to air hubs in proportion to a projection of their respective shares of the total. This procedure may be used for all large, medium and small hubs, but has been limited in this project to twenty-five large hubs. Table 2A lists percentage shares of national domestic freight (including express) enplanements at each of the twenty-five large hubs which were derived from the base year airport activity extracted by TSC from the CAB Airline Service Segment data. Domestic mail enplanements were separately derived by others and incorporated here. A study of CAB Airport Activity Statistics over the recent historical record indicates no significant instabilities. The hub shares are projected to be essentially constant for the forecast years. However, these market shares could be varied for each forecast year if independent analysis indicated significant trends for one or more hubs or for one or more of the services.

Table 2A. Hub Share of Domestic Cargo Enplanements.

Hub	Freight & Express lbs. (000)	Freight & Express Hub % of System Total Enplanements	Mail Hub % of System Total Enplanements
ATL	231,542	4.71	8.07
BOS	126,370	2.57	2.74
CHI	667,892	13.60	8.29
CLE	102,456	2.08	1.48
DAL/FTW	138,940	2.83	3.68
DEN	104,154	2.12	1.90
DTW	172,732	3.52	2.66
HNL	93,042	1.89	0.62
IAH	77,744	1.58	1.83
KAN	41,327	0.84	2.25
LAS	5,859	0.12	0.20
LOS ANG	598,323	12.18	5.17
MIA/FTL	144,860	2.95	1.58
MSP	92,310	1.88	2.50
MSY	30,080	0.61	0.80
NYC/NWK	614,621	12.51	11.12
PHL	109,700	2.23	2.82
PHX	25,272	0.51	0.77
PIT	48,528	0.99	1.67
STL	60,973	1.24	2.41
SFO/OAK	369,603	7.52	3.77
SJU	68,246	1.39	0.43
SEA/TAC	156,563	3.19	1.94
WAS/BLT	92,452	1.88	7.16
TPA	29,084	0.59	0.91
Total Large Hubs	4,202,673	85.53	76.77
Total All U.S. Airports	4,912,148	100.00	100.00

Source: (F&E) CAB Air Service Segment Data, 12 months ending March 31, 1975; (Mail) Washington Data Processing, Inc., Forecasting Models for Domestic and International Air Mail, June 1976, for FAA Office of Aviation.

For international enplanements at U.S. airports, percentage shares shown on Table 2B are derived from Department of Commerce data on exports by air. This data source is superior to CAB airport activity statistics in that total export enplanements by all carriers including foreign flag carriers are provided, whereas the CAB data does not include foreign flag activity. The percentage distribution of the national aggregate freight and express tons enplaned at U.S. airports was used for international mail enplanements because no such hub share analysis was included in the basic source for the mail forecasts. Hub shares for domestic services, international services, freight (including express) and mail are estimated separately. The separate elements of "cargo" (i.e., freight, express and mail) are aggregated for the domestic and for the international services just before input to the computer program. Tables B-14, B-26, and B-38 in Appendix B of this paper show the results of distributing the national aggregate enplanements for each of the cargo elements and the aggregation by hub.

2.2 PROJECTION OF PASSENGER FLEET LOWER HOLD CARGO CAPACITY BY HUB

2.2.1 PROJECTED PAX AIRCRAFT SIZE

The lower hold capacity of the passenger fleet serving each hub is a function of the size of the aircraft providing the passenger service at the hub and the number of departures.

Aircraft size will be examined first. Analysis of the various types of aircraft*, their respective average available seats, and the available lower hold cargo capacity (allowing 200 lbs. per passenger and baggage) indicates a direct relationship between available seats and available cargo tons per airplane departure. (See Figures 1A and 1B.) The CAB airline service segment data provides the means to

* Aircraft types considered--narrow body jets with two engines, three engines, and four engines; and wide body jets with three engines and four engines; and all others. Source: CAB Aircraft Operating and Performance Statistics.

Table 2B. Hub Share of U.S.-International Cargo Enplanements.

Hub	Tons Exported (F&E)	Hub % System Total
ATL	3,145	0.19
BOS	39,615	2.43
CHI	151,697	9.31
CLE	8,257	0.46
DAL/FTW	7,470	0.20
DEN	2,000	0.12
DTW	35,594	2.18
HNL	20,000	1.20
IAH	23,450	1.44
KAN	675	0.40
LAS	100	0.01
LOS ANG	104,616	6.42
MIA/FTL	216,291	13.28
MSP	3,186	0.20
MSY	7,992	0.49
NYC/NWK	643,135	39.48
PHL	15,000	0.92
PHX	200	0.01
PIT	750	0.05
STL	275	0.02
SFO/OAK	61,804	3.79
SJU	13,928	0.86
SEA/TAC	10,872	0.67
WAS/BLT	10,441	0.65
TPA	1,147	0.07
Total Large Hubs	1,381,640	84.85
Total All U.S. Airports	1,628,917	100.00

Source: U.S. Department of Commerce, Bureau of the Census. U.S. Exports by Air, 1974.

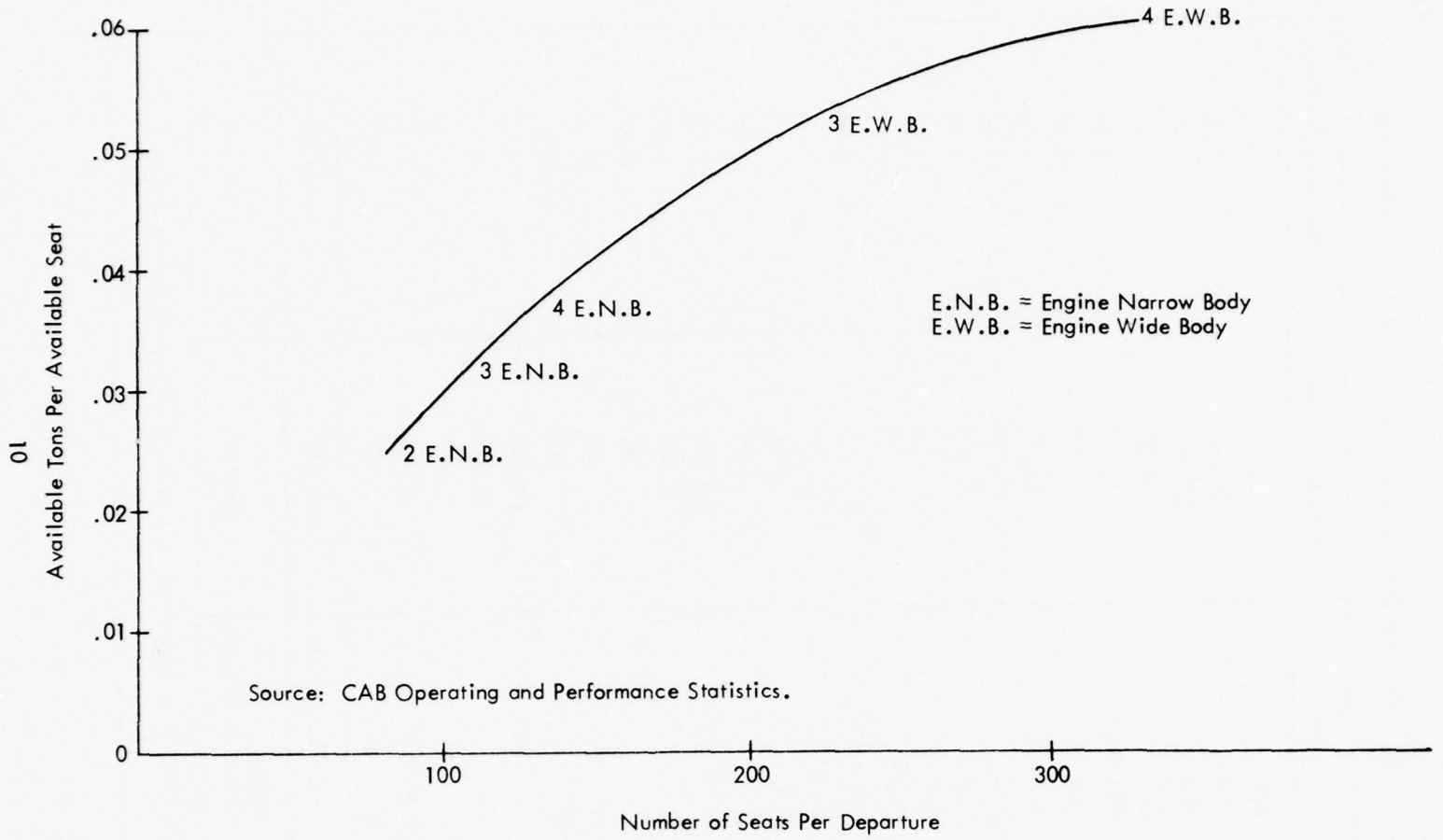

Figure 1A. Domestic - Passenger Aircraft Lower Hold Cargo Capacity.

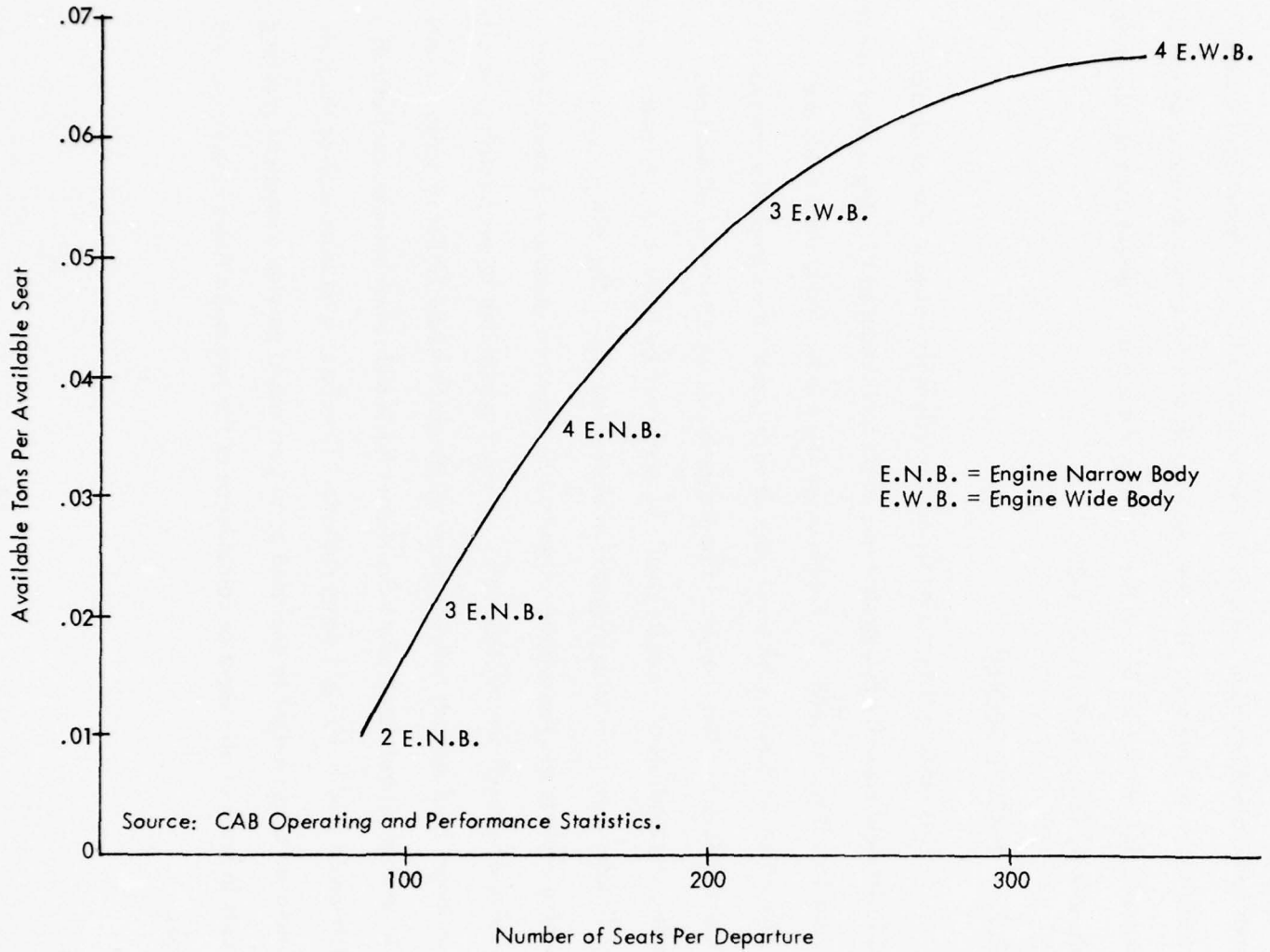

Figure 1B. International - Passenger Aircraft Lower Hold Cargo Capacity.

represent the current mix of aircraft types serving each hub and route in terms of an average number of available seats per departure. The growth trend of this average for each hub and route can be assumed to reflect the system-wide growth trend in equipment mix and average seats per departure. Therefore, the system historical trends and projections have been developed for domestic and international systems and are shown in Figure 2. The average aircraft size for each hub (and each market group which is explained below) derived from the service segment data are shown in Appendix B, Tables B-8, B-20, B-32.

2.2.2 MARKET GROUPS

It is obvious from the non-linear relationship between size of aircraft and lower hold capacity that gross errors could be introduced by using a single average aircraft for all routes served by flights departing a hub. Many short hauls and smaller cities are served with small aircraft with greater than proportionate reductions in lower hold capacities than would be indicated by an average of all markets. Ideally, the analysis of capacity should be performed by individual city-pair. Economy dictates some form of aggregation of markets by type. The criteria selected for grouping markets was the relative alignment of cargo and passenger demand rather than size of aircraft serving the route. It was reasoned that larger aircraft generally serve longer haul markets between major cities which would be heavy cargo markets, while smaller aircraft generally serve shorter hauls and routes between smaller cities which would tend to be light cargo markets. Therefore, a measure such as the ratio of enplaned cargo weight to enplaned passengers would provide a means of grouping markets in terms of alignment or coincidence of the two major flows - passenger and cargo.

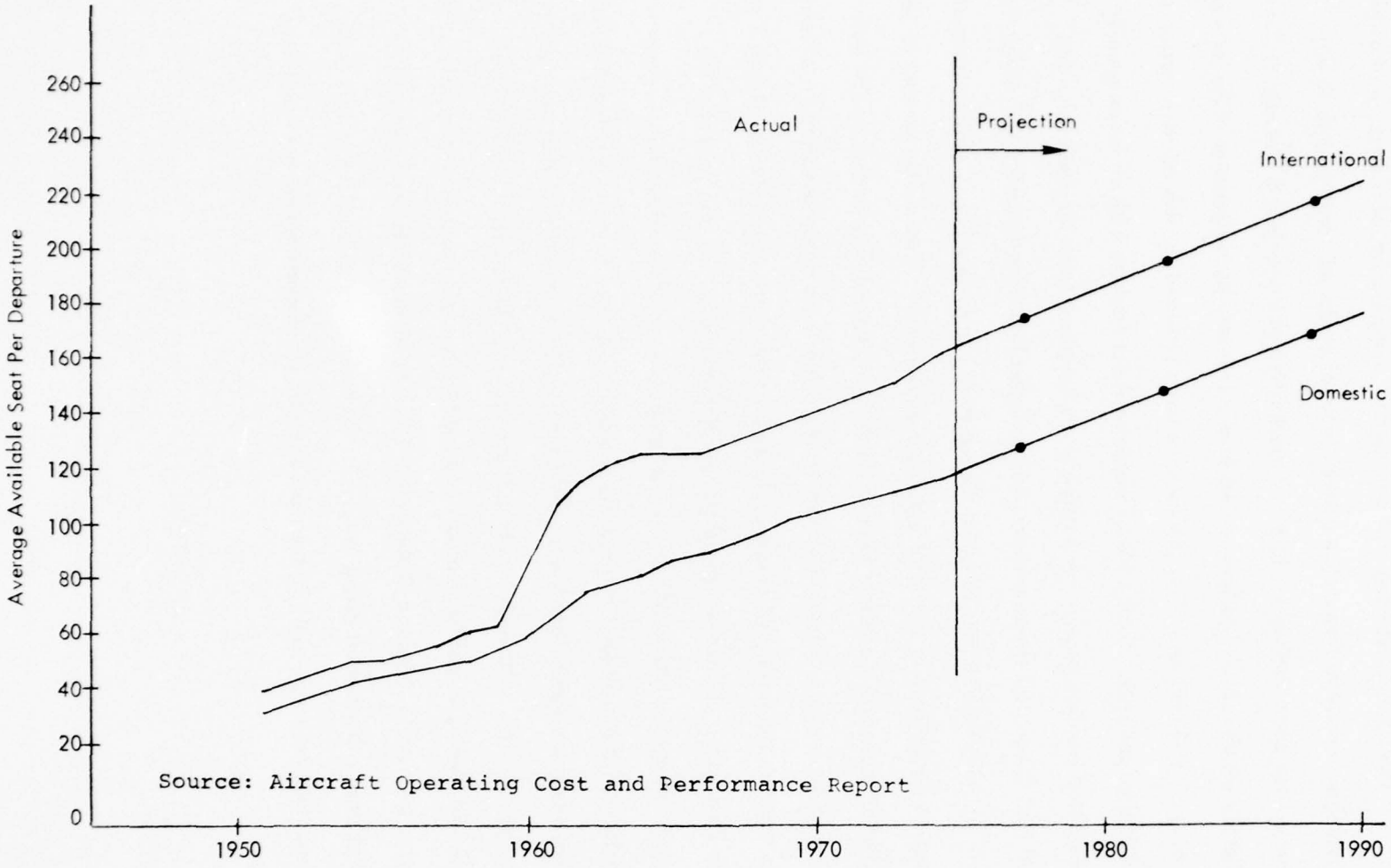

Figure 2. U.S. Flag Carrier - Average Available Seats Per Departure.

The CAB service segment data permits computation of a measure of alignment of passenger and cargo flow. The current ratio of enplaned cargo pounds to enplaned passengers for each on-flight origin and destination pair provides a measure or index number by which all destinations served from a hub may be assigned to either one of several groups of markets. Two groups have been selected for this current version of the computer program. Group No. 1 contains those markets with an index greater than the weighted average pounds per passenger enplanement ratio for each hub, and Group No. 2 contains those markets with an index less than the average. Assigning each origin-destination pair to either Group No. 1 or Group No. 2 permits computation of the percentage of the total passenger enplanements from a hub flowing to each group of markets and the percentage of the total cargo enplanements from the hub flowing to each group of markets. Therefore, using these group percentages of total enplanements, the projected cargo enplanements input are split between Group 1 and Group 2 markets. Likewise, the passenger enplanements and consequently the passenger fleet capacity is split by market group. Thus, for a given hub, a large percentage of the projected cargo demand may be assigned to a small percentage of the projected passenger fleet lower hold capacity if the majority of that capacity is in low cargo markets. Although inputs to the model are limited to hub level detail, all the demand inputs, capacity measures and load factors are computed internally at the market group level. Tables B-2 through B-43 in Appendix B display intermediate calculations at this market group level. In the subsequent discussions in this paper, all computational steps apply to the market group level even though not explicitly stated.

2.2.3 ESTIMATING PAX FLIGHT DEPARTURES

Estimating the number of departures of the "average" passenger airplane to each market group at each hub is the next step in the procedure. The number of departures is calculated by multiplying the average seats per departure, obtained from the previous step, by an average passenger enplanement load factor* and dividing this product into the projected passenger enplanements. The model accepts, as input, a passenger enplanement forecast for each hub for each service (i.e., domestic and international). Appendix A details the steps taken by TSC to produce the required passenger demand inputs from the latest FAA Terminal Area Forecasts. Tables B-14, B-26 and B-38 in Appendix B list the values used for the base projections. The model also accepts, as input, a projected system average passenger enplanement load factor, which is used internally to project the individual hub/market passenger enplanement load factors developed from the base period service segment data. These projected hub/market passenger enplanement load factors are shown in Tables B-9, B-21 and B-33 of Appendix B.

2.2.4 TOTAL LOWER HOLD CAPACITY

The total lower hold capacity, in tons, theoretically available to a hub/market is therefore the product of the average lower hold capacity per departure and the total number of departures of passenger flights as indicated above.

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*The passenger enplanement load factor is that percent of the theoretically available seats actually used by the specific hub. An airport on a multistop route may consistently use a small portion of a large airplane because the upstream or downstream airports use the remaining capacity. A much larger number of flights may service such an airport than would be indicated by the local enplanements.

2.3 ALLOCATION OF PROJECTED HUB/MARKET CARGO TO PAX LOWER HOLDS AND ESTIMATING RESIDUAL DEMAND

2.3.1 USABLE CAPACITY

All of this theoretical lower hold capacity departing a hub/market is not necessarily available for use by that hub/market. Some heavy passenger flows are not coincident with the cargo "demand"* because of departure schedules. Also, as stated above relative to passenger enplanements, an airport on a multistop route may consistently use a small portion of a large airplane because the upstream or downstream airports use the remaining capacity. A much smaller capacity may be available to such an airport than would be indicated by the theoretical capacity. Some means is required to discount the theoretical lower hold capacity which is unusable because of this mismatch of passenger and cargo schedules and/or because of the multistop service on certain routes. The CAB service segment data permits computation of *a current and projected hub lower hold enplanement load factor,*** which is a reflection of the above situations as the system is now operated. Tables B-18, B-30 and B-42 in Appendix B list the projected total lower hold usable capacity for each hub/market.

2.3.2 ALLOCATION TO LOWER HOLDS

The previous step provides the means of estimating the passenger fleet lower hold capacity available for cargo service. Projected cargo tonnage is next allocated to the lower holds by market group, out of each hub, until this "usable" lower hold capacity of the market group is exhausted and a residual demand remains which must be satisfied by freighter departures or left unsatisfied. Surplus lower hold capacity in

*True origin to destination cargo demand cannot be measured at the present time because true O&D statistics are not available. Demand in this case refers to the on-flight O&D which should be adequate for the airport activity interest.

**Lower hold enplanement load factor is that portion of the theoretical available capacity actually used by the specific hub.

one market group is of no use in another market and must be wasted. The usable lower hold capacity in each hub, to each market group is in part determined by the passenger and cargo demand splits into the market groups and in part by the projected lower hold enplanement load factor and the average aircraft size serving the group. The computer program constructs the groups, assigns demands and calculates unique aircraft size and load factor values from the inputs. Allocations to lower hold service in the aggregate are determined to a large extent by the exogenous and independent projections of the demands and the system average values for aircraft size and enplanement load factors. Page 1 of Table 3 lists the values used as inputs for the base projections which were derived by concensus among the project analysts and FAA and TSC project management. Having allocated the total cargo demand to the lower holds until either the usable capacity or the demand are exhausted, any residual demand for a market group is assigned to freighters.

2.4 TRANSLATION OF RESIDUAL CARGO DEMAND INTO FREIGHTER DEPARTURES

Annual freighter departures to each market group from an air hub are a function of the annual tonnage to be lifted, the freighter fleet mix serving the hub/market and the enplanement load factor. Having developed the projections of the residual tonnage demand requiring freighter lift to each market group, these later factors must be estimated. Analysis of the system-wide trends in the growth of aircraft and the portion of available airplane capacity used by each hub/market yields measures which adequately reflect the development of the freighter fleet and air carriers current practices of aircraft assignment, routing and scheduling. It can be assumed that the general pattern of route assignment of equipment and scheduling will not change radically, that the average size of freighter aircraft will continue to gradually

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers.

HUB: ATL (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	195567.	1253.
TOT TONS ENPL PAX L. H.:	149269.7	991.3
AV. SEATS/DEPARTURE:	115.2	120.5
AV. PAX ENPL. L. F.: (%)	54.6	54.6
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	7170.6	4772.5
AV. L. H. CARGO ENPL L. F.: (%)	21.3	33.2
NO. FRTR FLTS.:	2089.0	0.0
TOT TONS ENPL FRTR:	18463.6	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	57042.	0.
AV. FRTR ENPL. L. F.: (%)	31.0	0.0

HUB: BOS (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	81005.	5539.
TOT TONS ENPL PAX L. H.:	48031.9	5955.2
AV. SEATS/DEPARTURE:	111.5	156.8
AV. PAX ENPL. L. F.: (%)	48.7	44.4
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	7037.6	13008.9
AV. L. H. CARGO ENPL L. F.: (%)	16.9	16.5
NO. FRTR FLTS.:	1859.0	274.0
TOT TONS ENPL FRTR:	33149.0	3928.8
AV. FRTR CAPACITY/DEPT.(LBS):	82828.	80842.
AV. FRTR ENPL. L. F.: (%)	43.1	35.5

HUB: CHI (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	261670.	4949.
TOT TONS ENPL PAX L. H.:	238005.2	11308.2
AV. SEATS/DEPARTURE:	120.2	158.0
AV. PAX ENPL. L. F.: (%)	59.2	53.7
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8991.1	14188.5
AV. L. H. CARGO ENPL L. F.: (%)	20.2	32.2
NO. FRTR FLTS.:	12321.3	923.7
TOT TONS ENPL FRTR:	184253.6	22167.5
AV. FRTR CAPACITY/DEPT.(LBS):	76789.	89793.
AV. FRTR ENPL. L. F.: (%)	38.9	53.5

HUB: CLE (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	55772.	123.
TOT TONS ENPL PAX L. H.:	40787.9	136.2
AV. SEATS/DEPARTURE:	106.8	123.1
AV. PAX ENPL. L. F.: (%)	45.8	35.0
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	6591.9	15608.5
AV. L. H. CARGO ENPL L. F.: (%)	22.2	14.2
NO. FRTR FLTS.:	1323.0	0.0
TOT TONS ENPL FRTR:	21460.9	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	90667.	0.
AV. FRTR ENPL. L. F.: (%)	35.8	0.0

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

HUB: DAL/FTW (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	133930.	2576.
TOT TONS ENPL PAX L. F.:	81675.1	1936.3
AV. SEATS/DEPARTURE:	116.5	142.1
AV. PAX ENPL. L. F.: (%)	44.5	42.3
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8334.4	12269.0
AV. L. H. CARGO ENPL L. F.: (%)	14.6	12.3
NO. FRTR FLTS.:	2483.0	0.0
TOT TONS ENPL FRTR:	21614.5	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	56998.	0.
AV. FRTR ENPL. L. F.: (%)	37.5	0.0

HUB: DEN (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	94665.	1013.
TOT TONS ENPL PAX L. F.:	64443.1	1536.6
AV. SEATS/DEPARTURE:	111.2	113.9
AV. PAX ENPL. L. F.: (%)	49.9	55.8
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8439.7	6988.5
AV. L. H. CARGO ENPL L. F.: (%)	16.1	43.4
NO. FRTR FLTS.:	467.0	0.0
TOT TONS ENPL FRTR:	4002.7	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	57034.	0.
AV. FRTR ENPL. L. F.: (%)	37.1	0.0

HUB: DTW (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	72636.	2343.
TOT TONS ENPL PAX L. F.:	57881.3	2072.0
AV. SEATS/DEPARTURE:	116.8	127.0
AV. PAX ENPL. L. F.: (%)	42.6	33.0
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8981.9	9618.8
AV. L. H. CARGO ENPL L. F.: (%)	17.7	18.4
NO. FRTR FLTS.:	3102.8	187.2
TOT TONS ENPL FRTR:	47592.7	3097.9
AV. FRTR CAPACITY/DEPT.(LBS):	83025.	76686.
AV. FRTR ENPL. L. F.: (%)	36.9	43.2

HUB: HNL (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	38814.	2745.
TOT TONS ENPL PAX L. F.:	41121.5	9468.0
AV. SEATS/DEPARTURE:	155.2	254.9
AV. PAX ENPL. L. F.: (%)	60.8	42.0
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	9286.2	27555.5
AV. L. H. CARGO ENPL L. F.: (%)	22.8	25.0
NO. FRTR FLTS.:	2316.0	484.0
TOT TONS ENPL FRTR:	17649.5	9017.4
AV. FRTR CAPACITY/DEPT.(LBS):	36244.	74445.
AV. FRTR ENPL. L. F.: (%)	42.1	50.1

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

HUB: IAH (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	52884.	1816.
TOT TONS ENPL PAX L. H.:	33754.0	1505.8
AV. SEATS/DEPARTURE:	117.0	102.1
AV. PAX ENPL. L. F.: (%)	44.2	46.0
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8678.0	6412.8
AV. L. H. CARGO ENPL L. F.: (%)	14.7	25.9
NO. FRTR FLTS.:	861.0	0.0
TOT TONS ENPL FRTR:	16531.7	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	71065.	0.
AV. FRTR ENPL. L. F.: (%)	54.0	0.0

HUB: KAN (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	50962.	97.
TOT TONS ENPL PAX L. H.:	29707.5	14.2
AV. SEATS/DEPARTURE:	100.5	127.2
AV. PAX ENPL. L. F.: (%)	41.0	49.5
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	6817.5	9948.1
AV. L. H. CARGO ENPL L. F.: (%)	17.1	2.9
NO. FRTR FLTS.:	542.3	22.7
TOT TONS ENPL FRTR:	5598.2	143.7
AV. FRTR CAPACITY/DEPT.(LBS):	75267.	75260.
AV. FRTR ENPL. L. F.: (%)	27.4	16.8

HUB: LAS (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	41310.	368.
TOT TONS ENPL PAX L. H.:	4141.3	15.4
AV. SEATS/DEPARTURE:	114.8	96.8
AV. PAX ENPL. L. F.: (%)	51.1	43.8
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	7150.1	4979.9
AV. L. H. CARGO ENPL L. F.: (%)	2.8	1.7
NO. FRTR FLTS.:	2.0	0.0
TOT TONS ENPL FRTR:	21.9	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	76240.	0.
AV. FRTR ENPL. L. F.: (%)	28.7	0.0

HUB: LOS ANG (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	129047.	5507.
TOT TONS ENPL PAX L. H.:	184847.6	13161.8
AV. SEATS/DEPARTURE:	142.1	209.6
AV. PAX ENPL. L. F.: (%)	46.8	43.5
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	11997.9	19208.3
AV. L. H. CARGO ENPL L. F.: (%)	23.9	24.9
NO. FRTR FLTS.:	8472.7	227.3
TOT TONS ENPL FRTR:	159771.0	2337.6
AV. FRTR CAPACITY/DEPT.(LBS):	82371.	76137.
AV. FRTR ENPL. L. F.: (%)	45.8	27.0

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

HUB: MIA/FTL (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	97794.	9806.
TOT TONS ENPL PAX L. H.:	67209.9	11654.4
AV. SEATS/DEPARTURE:	132.3	136.8
AV. PAX ENPL. L. F.: (%)	43.6	53.6
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	9374.2	8382.3
AV. L. H. CARGO ENPL L. F.: (%)	14.7	28.4
NO. FRTR FLTS.:	954.0	1028.0
TOT TONS ENPL FRTR:	18625.7	31247.2
AV. FRTR CAPACITY/DEPT.(LBS):	70999.	77680.
AV. FRTR ENPL. L. F.: (%)	55.0	78.3

HUB: MSP (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	61207.	1503.
TOT TONS ENPL PAX L. H.:	52769.2	2774.8
AV. SEATS/DEPARTURE:	115.8	132.1
AV. PAX ENPL. L. F.: (%)	44.0	41.1
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	9287.0	14996.4
AV. L. H. CARGO ENPL L. F.: (%)	18.6	24.6
NO. FRTR FLTS.:	696.0	1.0
TOT TONS ENPL FRTR:	11431.5	0.1
AV. FRTR CAPACITY/DEPT.(LBS):	62962.	72840.
AV. FRTR ENPL. L. F.: (%)	52.2	0.3

HUB: MSY (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	40545.	637.
TOT TONS ENPL PAX L. H.:	19251.4	596.8
AV. SEATS/DEPARTURE:	114.8	131.2
AV. PAX ENPL. L. F.: (%)	44.1	34.6
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	7649.9	5700.6
AV. L. H. CARGO ENPL L. F.: (%)	12.4	32.9
NO. FRTR FLTS.:	140.0	0.0
TOT TONS ENPL FRTR:	833.4	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	94144.	0.
AV. FRTR ENPL. L. F.: (%)	12.6	0.0

HUB: NYC/NWK (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	224336.	20081.
TOT TONS ENPL PAX L. H.:	184943.7	54688.0
AV. SEATS/DEPARTURE:	122.5	185.8
AV. PAX ENPL. L. F.: (%)	51.8	50.5
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8231.3	16134.2
AV. L. H. CARGO ENPL L. F.: (%)	20.0	33.8
NO. FRTR FLTS.:	11169.2	2610.8
TOT TONS ENPL FRTR:	219145.4	74387.6
AV. FRTR CAPACITY/DEPT.(LBS):	82725.	89938.
AV. FRTR ENPL. L. F.: (%)	47.4	63.4

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

HUB: PHL (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	65480.	2020.
TOT TONS ENPL PAX L. H.:	45864.3	1347.8
AV. SEATS/DEPARTURE:	113.3	143.5
AV. PAX ENPL. L. F.: (%)	43.8	35.3
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	7376.7	10464.1
AV. L. H. CARGO ENPL L. F.: (%)	19.0	12.8
NO. FRTR FLTS.:	2454.0	148.0
TOT TONS ENPL FRTR:	29245.4	1045.2
AV. FRTR CAPACITY/DEPT.(LBS):	76772.	75759.
AV. FRTR ENPL. L. F.: (%)	31.0	18.6

HUB: PIT (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	87239.	936.
TOT TONS ENPL PAX L. H.:	37409.0	360.8
AV. SEATS/DEPARTURE:	95.6	109.4
AV. PAX ENPL. L. F.: (%)	42.0	30.2
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	5192.6	5253.7
AV. L. H. CARGO ENPL L. F.: (%)	16.5	14.7
NO. FRTR FLTS.:	4.0	0.0
TOT TONS ENPL FRTR:	44.7	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	75995.	0.
AV. FRTR ENPL. L. F.: (%)	29.4	0.0

HUB: STL (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	84485.	119.
TOT TONS ENPL PAX L. H.:	41121.3	38.4
AV. SEATS/DEPARTURE:	97.6	130.0
AV. PAX ENPL. L. F.: (%)	42.7	40.3
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	5915.0	9031.8
AV. L. H. CARGO ENPL L. F.: (%)	16.5	7.1
NO. FRTR FLTS.:	702.9	4.1
TOT TONS ENPL FRTR:	7480.8	72.5
AV. FRTR CAPACITY/DEPT.(LBS):	75261.	75264.
AV. FRTR ENPL. L. F.: (%)	28.3	46.8

HUB: SFO/OAK (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	100013.	3677.
TOT TONS ENPL PAX L. H.:	100551.1	10500.5
AV. SEATS/DEPARTURE:	128.9	203.4
AV. PAX ENPL. L. F.: (%)	47.4	35.3
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	9265.6	21647.2
AV. L. H. CARGO ENPL L. F.: (%)	21.7	26.4
NO. FRTR FLTS.:	6496.4	960.6
TOT TONS ENPL FRTR:	120579.9	24165.4
AV. FRTR CAPACITY/DEPT.(LBS):	84798.	78296.
AV. FRTR ENPL. L. F.: (%)	43.8	64.3

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

HUB: SJU (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	14084.	4219.
TOT TONS ENPL PAX L. H.:	19499.4	4221.8
AV. SEATS/DEPARTURE:	201.8	125.4
AV. PAX ENPL. L. F.: (%)	58.9	43.4
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	15733.1	6977.6
AV. L. H. CARGO ENPL L. F.: (%)	17.6	28.7
NO. FRTR FLTS.:	955.0	2.0
TOT TONS ENPL FRTR:	16962.6	42.1
AV. FRTR CAPACITY/DEPT.(LBS):	80331.	123502.
AV. FRTR ENPL. L. F.: (%)	44.2	34.1

HUB: SEA/TAC (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	45050.	2561.
TOT TONS ENPL PAX L. H.:	68204.6	3515.1
AV. SEATS/DEPARTURE:	139.4	173.1
AV. PAX ENPL. L. F.: (%)	42.0	41.7
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	12255.4	14162.6
AV. L. H. CARGO ENPL L. F.: (%)	24.7	19.4
NO. FRTR FLTS.:	1824.5	316.5
TOT TONS ENPL FRTR:	26625.3	5638.6
AV. FRTR CAPACITY/DEPT.(LBS):	84071.	82092.
AV. FRTR ENPL. L. F.: (%)	34.7	43.4

HUB: WAS/BLT (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	155761.	3629.
TOT TONS ENPL PAX L. H.:	83312.7	4856.6
AV. SEATS/DEPARTURE:	102.1	149.1
AV. PAX ENPL. L. F.: (%)	46.8	45.0
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	5920.1	11017.6
AV. L. H. CARGO ENPL L. F.: (%)	18.1	24.3
NO. FRTR FLTS.:	563.9	104.1
TOT TONS ENPL FRTR:	8838.3	1312.6
AV. FRTR CAPACITY/DEPT.(LBS):	76217.	71146.
AV. FRTR ENPL. L. F.: (%)	41.1	35.4

HUB: TPA (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	45382.	488.
TOT TONS ENPL PAX L. H.:	20628.3	45.1
AV. SEATS/DEPARTURE:	127.2	139.3
AV. PAX ENPL. L. F.: (%)	39.8	28.1
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	9105.3	9863.3
AV. L. H. CARGO ENPL L. F.: (%)	10.0	1.9
NO. FRTR FLTS.:	0.0	0.0
TOT TONS ENPL FRTR:	0.0	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	0.	0.
AV. FRTR ENPL. L. F.: (%)	0.0	0.0

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

HUB: PHX (ACTUAL)	DOM	INT
NO. PAX FLT DEPT.:	42467.	547.
TOT TONS ENPL PAX L.-H.:	18110.0	68.2
AV. SEATS/DEPARTURE:	113.3	103.1
AV. PAX ENPL. L. F.: (%)	40.7	34.7
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8214.9	5395.5
AV. L. H. CARGO ENPL L. F.: (%)	10.4	4.6
NO. FRTR FLTS.:	0.0	0.0
TOT TONS ENPL FRTR:	0.0	0.0
AV. FRTR CAPACITY/DEPT.(LBS):	0.	0.
AV. FRTR ENPL. L. F.: (%)	0.0	0.0

Table 3. Actual CAB Airline Service Segment Data, April 1974 - March 1975 - U.S. Flag Carriers (Continued).

AVERAGES AND TOTALS OF LISTED HUBS	DCM	INT
NO. PAX FLT DEPT.:	2272102.	78555.
TOT TONS ENPL PAX L. F.:	1732540.9	142769.3
AV. SEATS/DEPARTURE:	118.2	163.4
AV. PAX ENPL. L. F.: (%)	47.6	46.2
AV. L. H. CARGO CAPACITY/DEPT.(LBS):	8244.8	13491.7
AV. L. H. CARGO ENPL L. F.: (%)	18.5	26.9
NO. FRTR FLTS.:	61799.1	7293.9
TOT TONS ENPL FRTR:	989922.3	178604.3
AV. FRTR CAPACITY/DEPT.(LBS):	77077.	83576.
AV. FRTR ENPL. L. F.: (%)	41.6	58.6

increase, and that capacity utilization will gradually increase to a more profitable level.

The CAB airline service segment data provides the current estimates of average freighter aircraft size serving each market group from each hub. Whereas the average passenger aircraft is measured in available seats per departure, as stated in a previous section, the average freighter aircraft is measured in available tons per departure. The trend in the growth of these hub/market unique averages can be assumed to reflect the system-wide trend in equipment mix and growth of average available tons per departure as derived from the CAB Aircraft Operating and Performance Statistics. The historical trend and projections are developed for domestic and international systems and are shown in Figure 3 and the unique values for each hub and each market group are shown in Table B-12, B-24 and B-36 of Appendix B.

Each market group from each hub experiences a different utilization of the freighter capacity per departure. The enplanement load factor* varies significantly, dependent on location within the network (e.g., east coast origin, west coast origin or intermediate stop in route). The current freighter enplanement load factors for each hub and group are computed from the service segment data using the aggregated available tons and the aggregated cargo enplanements and are shown in Table B-7 of Appendix B. The current enplanement load factors can be expected to increase gradually to reflect the increase in system average load factor. The projected average enplanement load factors for each hub and market group which are calculated from the system averages are shown in Tables B-13, B-25 and B-37.

*The percent of the theoretical available tons of lift of the average aircraft which is actually used by the hub.

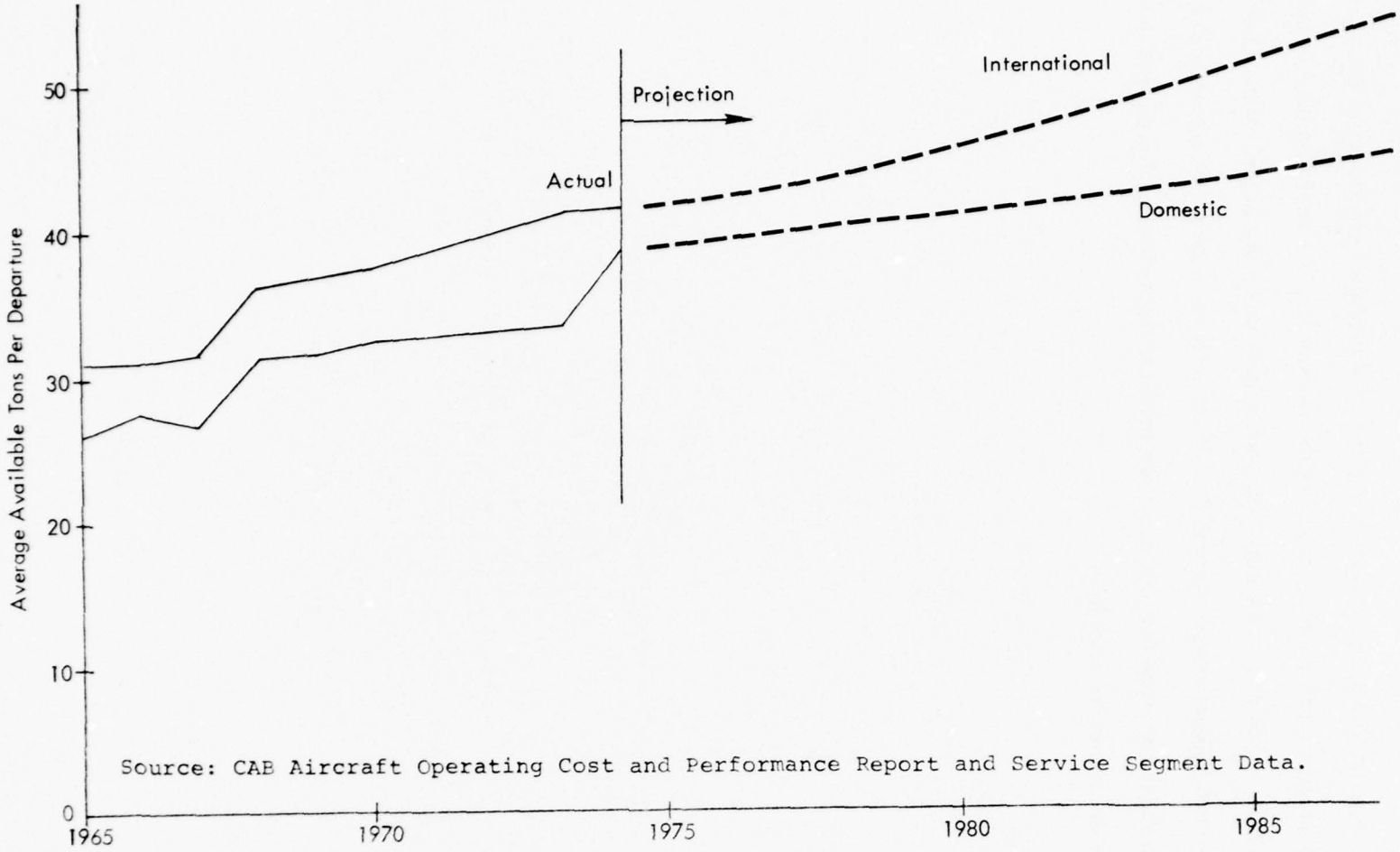

Figure 3. Freighter Capacity.

Application of the projected average enplanement load factors to the projected average aircraft capacity produces the average enplanement measured in tons per departure which can be expected for each market group out of each hub. Dividing the projected residual annual demand for lift capacity for each group out of each hub by the projected average tons per departure produces the estimates of projected annual freighter departures for each hub.

SECTION 3

HUB ACTIVITY PROJECTIONS - BASE FORECAST

The base projections of air hub activity for 1977, 1982 and 1987 reflect the growth trends of the national aggregate enplanements which imply an annual average of about 5% in domestic service and about 8% in international services.* Table 4 lists base projections for 25 large hubs individually and for the aggregate.

Examination of these base forecasts reveals a downward trend in domestic freighter operations, and an upward trend in international freighter operations. In both domestic and international passenger fleet, lower hold enplanements are trending upward.

3.1 U.S. DOMESTIC SERVICE

In domestic service, a substantial 37% reduction in freighter activity is forecast from 1975 to 1987, with 23% occurring by 1977. The tonnage enplaned in these freighter flights, however, decreases by only 4%; due to increased capacity and improved capacity utilization, the same cargo requires fewer aircraft departures.

Figure 4 shows plots of the trends in freighter departures during the forecast period for the aggregate of the 25 large hubs. The middle line is the projection using the passenger fleet lower hold enplanement load factors selected for the base projections. Domestically they are projected to increase from 18.5% in the base period to 24% in 1987. The upper line represents a high projection of freighter activity if the lower holds are not utilized even as much as they currently are. The lower line represents the lowest likely projection assuming some reasonable maximum utilization rate for lower holds.

*Including all scheduled and nonscheduled cargo services of U.S. and foreign flag carriers. The passenger departures are scheduled services only.

Table 4. Hub Projection Tables. Page 1 of 9

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SYSTEM AVERAGES USED FOR THE FOLLOWING FORECASTS ARE

	ACTUAL APR 74 - MAR 75		PROJECTED 1977		1982		1987	
	DOM	INT	DOM	INT	DOM	INT	DOM	INT
PAX ENPL L.F.: (%)	47.6	46.2	48.0	48.0	50.0	50.0	52.0	52.0
AV. AVAIL SEATS/FLT:	118.2	163.4	130.0	175.0	150.0	195.0	170.0	215.0
L.H. ENPL L.F.: (%)	18.5	26.9	20.0	30.0	22.0	35.0	24.0	40.0
FRTR ENPL L.F.: (%)	41.6	58.6	44.0	61.0	48.0	63.0	52.0	65.0
FRTR SIZE (TONS):	38.5	41.8	40.0	43.0	42.0	48.0	45.0	54.0

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F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

	1977		1982		1987	
HUB: ATL (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	203128	1322	223988	1432	257012	1625
LOWER HOLD CARGO(TONS):	169734	1538	211755	2690	268179	4303
FRTR FLT DEPT.:	0	22*	0	15*	0	9*
FRTR CARGO(TONS):	0	586	0	463	0	317
HUB: BOS (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	97158	7101	105628	7968	119733	9251
LOWER HOLD CARGO(TONS):	66696	10413	91831	18666	128039	31919
FRTR FLT DEPT.:	1820	1183	1548	1193	1199	1171
FRTR CARGO(TONS):	36172	16781	34083	21665	29398	27177
HUB: CHI (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	281196	13384	274433	15181	356147	17834
LOWER HOLD CARGO(TONS):	298919	36749	376511	53739	540447	77897
FRTR FLT DEPT.:	10932	2579	11718	3359	9978	4292
FRTR CARGO(TONS):	185649	67445	229329	100786	227921	148517
HUB: CLE (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	62051	332	66689	355	74876	381
LOWER HOLD CARGO(TONS):	52729	323	70506	545	95330	1030
FRTR FLT DEPT.:	1241	183*	1170	234*	1085	289*
FRTR CARGO(TONS):	23423	4823	24217	7088	24396	10156

*=NO FRTR FLIGHTS DURING BASE PERIOD. SYSTEM AVERAGES USED IN LIEU OF ACTUALS.

F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

HUB: DAL/FTW (FORECAST)	1977 DOM	1977 INT	1982 DOM	1982 INT	1987 DOM	1987 INT
PAX FLT DEPT.:	148653	2947	159924	3201	168470	3402
LOWER HOLD CARGO(TONS):	104909	2238	142060	3320	180278	4864
FRTR FLT DEPT.:	1307	0	207	0	0	0
FRTR CARGO(TONS):	14749	0	3048	0	0	0

HUB: DEN (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	98723	1266	107522	1358	122061	1525
LOWER HOLD CARGO(TONS):	80439	1343	100354	1992	126114	2918
FRTR FLT DEPT.:	88	0	0	0	0	0
FRTR CARGO(TONS):	928	0	0	0	0	0

HUB: DTW (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	83180	3823	96602	4246	101551	4324
LOWER HOLD CARGO(TONS):	77695	4755	107569	8919	140439	13889
FRTR FLT DEPT.:	3145	1208	2856	1295	2964	1493
FRTR CARGO(TONS):	52676	19641	54245	27263	63797	39126

HUB: HNL (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	40326	9241	47079	11114	56581	13722
LOWER HOLD CARGO(TONS):	53214	13430	79190	19017	101232	29184
FRTR FLT DEPT.:	872	0	453	0	0	0
FRTR CARGO(TONS):	9003	0	6821	0	0	0

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F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

	1977		1982		1987	
HUB: IAH (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	60009	6106	65353	6311	74096	6902
LOWER HOLD CARGO(TONS):	43199	6829	59768	12314	80188	19475
FRTR FLT DEPT.:	717	354*	787	383*	652	443*
FRTR CARGO(TONS):	15444	9285	19059	11585	18119	15544
HUB: KAN (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	52291	236	57366	263	64543	309
LOWER HOLD CARGO(TONS):	41084	96	54347	275	65586	607
FRTR FLT DEPT.:	420	496*	0	543*	0	595*
FRTR CARGO(TONS):	4974	4380	0	6363	0	9120
HUB: LAS (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	49180	370	55635	389	63536	422
LOWER HOLD CARGO(TONS):	5497	65	6581	165	8103	243
FRTR FLT DEPT.:	0	2*	0	0	0	0
FRTR CARGO(TONS):	0	46	0	0	0	0
HUB: LOS ANG (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	204977	16856	231447	19704	270236	23719
LOWER HOLD CARGO(TONS):	289499	48291	389431	76320	531544	113068
FRTR FLT DEPT.:	6094	1944	5877	1932	5341	2186
FRTR CARGO(TONS):	122764	23560	131193	30237	133083	43063

****

*=NO FRTR FLIGHTS DURING BASE PERIOD. SYSTEM AVERAGES USED IN LIEU OF ACTUALS.

F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

	1977		1982		1987	
HUB: MIA/FTL (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	113796	24962	126520	27745	145714	32032
LOWER HOLD CARGO(TONS):	86999	39643	115693	64594	156014	96600
FRTR FLT DEPT.:	671	3406	518	4186	286	5278
FRTR CARGO(TONS):	16007	108983	13595	155824	8377	226363
HUB: MSP (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	67698	1434	73565	1555	83260	1753
LOWER HOLD CARGO(TONS):	69341	2238	89950	3320	119392	4864
FRTR FLT DEPT.:	550	-0	308	0	36	0
FRTR CARGO(TONS):	10682	0	6906	0	945	0
HUB: MSY (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	46462	1410	50437	1501	57014	1661
LOWER HOLD CARGO(TONS):	25858	1859	31344	3455	38928	5979
FRTR FLT DEPT.:	0	138*	0	155*	0	169*
FRTR CARGO(TONS):	0	3624	0	4676	0	5935
HUB: NYC/NWK (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	265818	56127	295244	65513	340516	78651
LOWER HOLD CARGO(TONS):	266181	178705	357911	274917	489407	419862
FRTR FLT DEPT.:	9638	8803	9636	11016	9484	13650
FRTR CARGO(TONS):	213202	266145	233408	380364	253825	540274

*=NO FRTR FLIGHTS DURING BASE PERIOD. SYSTEM AVERAGES USED IN LIEU OF ACTUALS.

F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

	1977		1982		1987	
HUB: PHL (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	71664	6205	77496	6694	87392	7549
LOWER HOLD CARGO(TONS):	61137	6092	81639	10130	111055	16231
FRTR FLT DEPT.:	2418	459	1982	423	1546	386
FRTR CARGO(TONS):	32383	4203	31927	5139	30169	6142
HUB: PIT (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	92586	1605	96571	1602	105876	1717
LOWER HOLD CARGO(TONS):	45544	560	54490	830	67057	1216
FRTR FLT DEPT.:	0	0	0	0	0	0
FRTR CARGO(TONS):	0	0	0	0	0	0
HUB: STL (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	86869	277	100189	322	109948	357
LOWER HOLD CARGO(TONS):	53845	127	71349	293	87310	486
FRTR FLT DEPT.:	510	5	0	2	0	0
FRTR CARGO(TONS):	6264	96	0	38	0	0
HUB: SFO/OAK (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	165134	11323	183675	12930	211979	15266
LOWER HOLD CARGO(TONS):	172791	25966	229110	36847	308151	52470
FRTR FLT DEPT.:	4018	609	4149	833	4211	1088
FRTR CARGO(TONS):	87308	16450	97956	26058	108222	39700

F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

	1977		1982		1987	
HUB: SJU (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	16559	10714	19948	11510	24646	12942
LOWER HOLD CARGO(TONS):	25849	9625	36952	14274	53467	20915
FRTR FLT DEPT.:	1024	0	971	0	849	0
FRTR CARGO(TONS):	19656	0	20903	0	20712	0
HUB: SEA/TAC (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	47430	4245	52955	4778	61211	5584
LOWER HOLD CARGO(TONS):	83058	4691	112093	6937	145606	10256
FRTR FLT DEPT.:	1881	142	1567	179	1554	217
FRTR CARGO(TONS):	30557	2806	29968	4182	34577	6037
HUB: WAS/BLT (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	169203	6559	167074	6711	195329	7287
LOWER HOLD CARGO(TONS):	116659	7275	142325	10788	168942	15808
FRTR FLT DEPT.:	440	0	0	0	0	0
FRTR CARGO(TONS):	8240	0	0	0	0	0
HUB: TPA (FORECAST)	DOM	INT	DOM	INT	DOM	INT
PAX FLT DEPT.:	53036	507	58093	524	65950	581
LOWER HOLD CARGO(TONS):	26321	179	31643	332	39074	542
FRTR FLT DEPT.:	0	23*	0	27*	0	33*
FRTR CARGO(TONS):	0	602	0	829	0	1159

*=NO FRTR FLIGHTS DURING BASE PERIOD. SYSTEM AVERAGES USED IN LIEU OF ACTUALS.

****

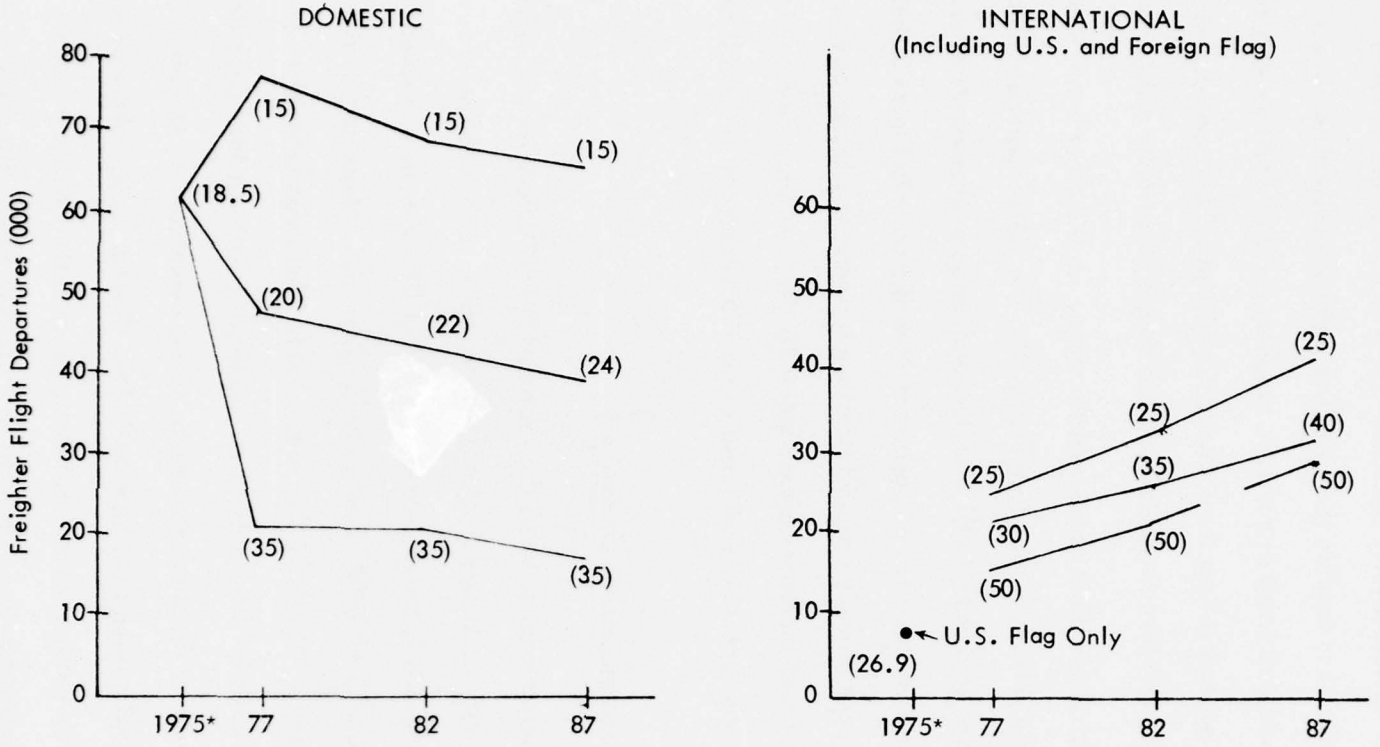
F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

HUB: PHX (FORECAST)	1977 DOM	1977 INT	1982 DOM	1982 INT	1987 DOM	1987 INT
PAX FLT DEPT.:	45744	666	48580	652	55131	715
LOWER HOLD CARGO(TONS):	22323	112	27191	166	33602	243
FRTR FLT DEPT.:	0	0	0	0	0	0
FRTR CARGO(TONS):	0	0	0	0	0	0

****

F O R E C A S T
BASE PERIOD: APR 74 - MAR 75 (U.S. FLAG PLUS FOREIGN FLAG ACTIVITY)

TOTALS (FORECAST)	1977 DOM	1977 INT	1982 DOM	1982 INT	1987 DOM	1987 INT
PAX FLT DEPT.:	2622871	189018	2842013	213559	3272808	249531
LOWER HOLD CARGO(TONS):	2339520	403142	3071593	624845	4083484	944869
FRTR FLT DEPT.:	47786	21556	43747	25775	39185	31299
FRTR CARGO(TONS):	890081	549456	936658	782560	953541	1118630



(24) Denotes Pax Lower Hold Enplanement Load Factor in Percent.

*12 Months Ending 3/31/75.

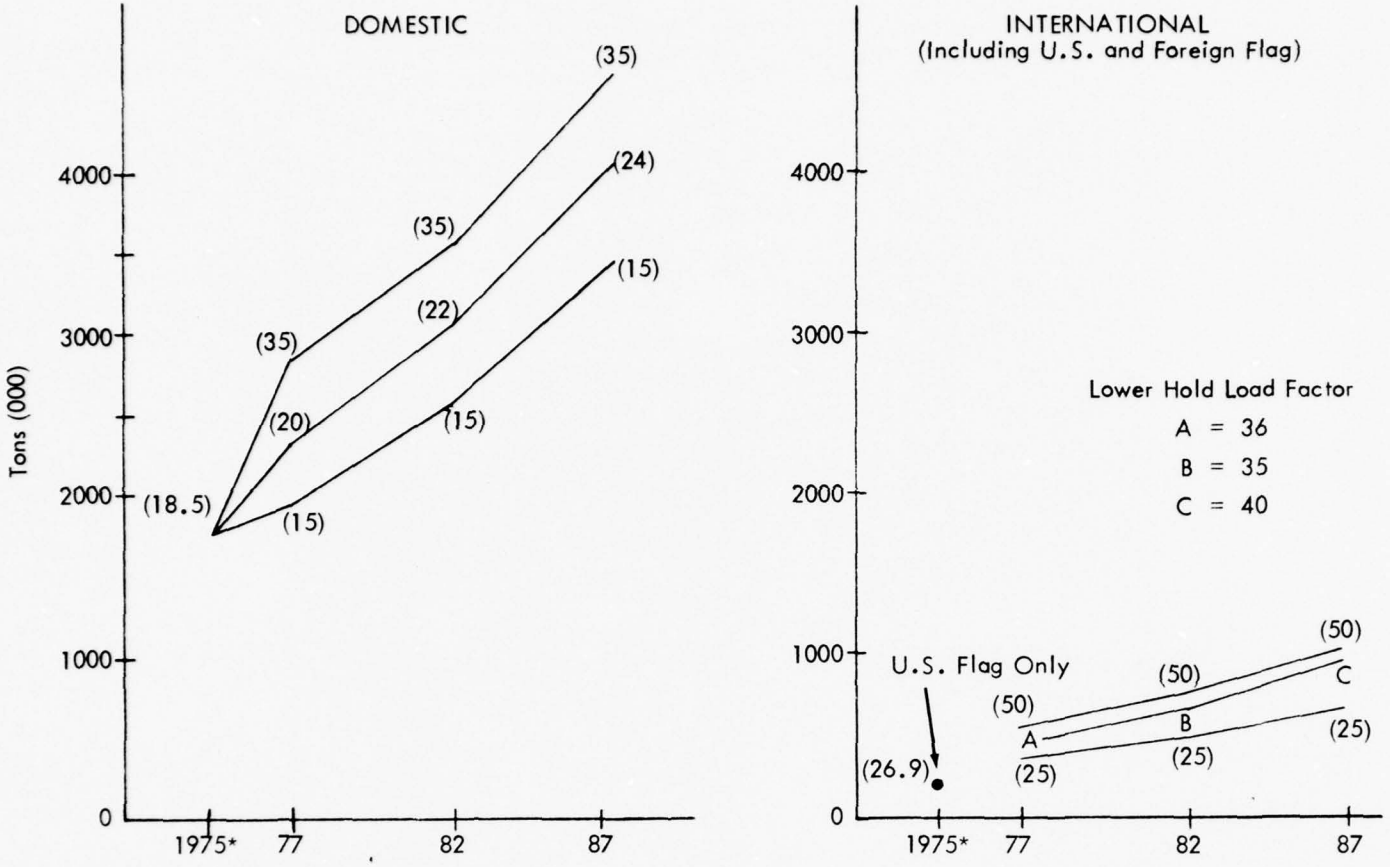
Figure 4. U.S. Airport Activity - Freighter Departures, 25 Large Hubs.

Figure 4 shows that the domestic freighter activity is unlikely to increase at all unless the carriers reverse the recent trend to greater use of lower holds in passenger flights. It is possible that with even greater emphasis on lower hold utilization that the downward trend in domestic freighter activity might even accelerate. These trends in general reflect the individual trends of all but one hub. Table 4 indicates that the San Francisco/Oakland hub should experience a slight increase.

Domestic lower hold cargo enplanements, on the other hand, show substantial increases over the forecast period (see Figure 5). The 136% aggregate increase would increase the lower hold share to 81% of the total cargo enplanements as compared to 64% share in the base period. It is apparent from the plots in Figure 5 that the cargo enplanement in passenger aircraft will continue to increase substantially even with utilization rates lower than the base period of 18.5%. An improvement in enplanement load factor to as much as 35% would result in a 175% increase in the domestic lower hold services.

3.2 U.S. INTERNATIONAL SERVICE

The international services show substantially different trends. Although comparisons against the base year statistics are cumbersome (because of lack of detailed foreign flag data), trends between 1977 and 1987 may be examined. In the aggregate, international freighter activity by U.S. and foreign flag carriers is projected to increase by 45% in the ten year period. The cargo tonnage to be enplaned in international freighter flights shows an increase of 104% in 1987 over 1977. This substantial increase in freighter enplanements and departures is projected even though the lower hold enplanements increase by 134%. The percentage share of enplaned tonnage carried by the lower holds of passenger aircraft remains at roughly 45% throughout the forecast period. In terms of individual hubs, all hubs with the exception of two show substantial increases in freighter activity. Philadelphia and Boston are projected to have a slight decrease between 1977 and 1987.



(24) Denotes Pax Lower Hold Enplanement Load Factor in Percent.

Figure 5. U.S. Airport Activity - Pax Lower Hold Cargo Enplanements, 25 Large Hubs.

APPENDIX A

PASSENGER ENPLANEMENT FORECAST

The FAA Terminal Area Forecast 1977-87 provides individual airport forecasts of total scheduled operations and enplanements but does not dissaggregate into domestic and international travel. To determine the percentage of enplanements from each hub bound for international destinations, it is necessary to combine CAB Airline Service Segment data and (I-92) U.S.-International Passenger travel data collected by the Immigration and Naturalization Service and processed by DOT.

The Airline Service Segment data is properly separated for the current (base) year, but only lists U.S. carriers. The missing counts are enplanements on foreign flag carriers providing international service; these are contained in the I-92 reports for the same base period (1974-75). The sum of these foreign flag carrier enplanements and U.S. carrier international enplanements is the total U.S. international enplanements for the base year. Dividing this total by the total overall traffic for each hub yields an international proportion of the total. This percentage is assumed to be constant for the forecast period. The base figures are listed in Table A-1.

The international and domestic demand values for each hub are then determined by summing the aggregate enplanement forecast of all airports in that hub listed in the Terminal Area Forecast, and splitting that sum in accordance with the international-domestic percentage split for the hub.

Because TAF forecasts are for fiscal years, additional extrapolation of the total was necessary to correct it to a calendar year base. For CY77, an

Table A-1. International Percentage of Hub Passenger Enplanements. *

Hub	Domestic	U.S. Carrier International	Foreign Carrier International	Total International	Total Dom. & Int'l	International % of Total
ATL	12,298	81	3	84	12,382	0.7
BOS	5,397	382	126	508	5,905	8.6
CHI	15,772	486	574	1,060	16,832	6.3
CLE	2,730	5	10	15	2,745	0.5
DAL/FTW	6,861	151	15	166	7,027	2.3
DEN	5,251	64	15	79	5,330	1.5
DTW	3,610	98	54	152	3,762	4.0
HNL	3,632	295	653	948	4,580	20.7
IAH	2,735	85	186	271	3,006	9.0
KAN	2,101	6	9	15	2,116	0.7
LAS	2,423	16	0	16	2,439	0.6
LOS ANG	8,833	501	502	1,003	9,836	10.2
MIA/FTL	5,562	723	873	1,596	7,158	22.3
MSP	3,121	75	0	75	3,196	2.3
MSY	2,053	28	29	57	2,110	2.8
NYC/NWK	14,216	1,885	2,501	4,386	18,602	23.6
PHL	3,248	101	197	298	3,546	8.4
PHX	1,959	20	4	24	1,983	1.2
PIT	3,498	56	0	56	3,554	1.5
STL	3,523	7	10	17	3,540	0.4
SFO/OAK	6,090	256	245	501	6,591	7.6
SJU	1,672	232	317	549	2,221	24.7
SEA/TAC	2,629	186	113	299	2,928	10.2
WAS/BLT	5,482	244	54	298	5,780	5.2
TPA	2,298	19	1	20	2,318	0.9

Sources: Domestic, U.S. Carrier International; CAB, Service Segment Data, 1974-1975; Foreign Carrier International; DOT I-92 Travel Study, 1974.

* Enplanements (000).

arithmetic mean of FY77 and FY78 was used; for CY82 and CY87, a linear extrapolation of the forecast from a FY82 point was assumed.

The resulting passenger enplanement forecasts are listed in Tables B-14, B-26 and B-38 of Appendix B.

APPENDIX B

HUB/MARKET TABLES

Table B-1

INDEX OF TABLES OF VARIABLES

Table B-2

ACTUAL AV. AVAIL SEATS PER DEPT (SYS=118) (SYS=163)

	DOM1	DOM2	INT1	INT2
ATL	138	105	134	113
BOS	134	101	221	143
CHI	152	108	328	142
CLE	118	103	233	114
DAL/FTW	126	111	138	148
DEN	126	102	116	95
DTW	140	106	219	100
HNL	167	131	206	292
IAH	135	112	95	104
KAN	100	100	123	127
LAS	103	117	95	104
LOS ANG	176	123	296	158
MIA/FTL	155	126	148	134
MSP	133	109	102	139
MSY	118	111	118	133
NYC/NWK	147	111	235	169
PHL	137	103	184	122
PIT	102	89	107	118
STL	106	92	129	130
SFO/OAK	165	118	315	170
SJU	242	153	131	123
SEA/TAC	181	128	360	145
WAS/BLT	112	94	236	118
TPA	128	126	116	144
PHX	126	104	114	100

Table B-3

ACTUAL HUB PAX ENPL LOAD FACTORS (SYS= .476) (SYS= .462)

	DOM1	DOM2	INT1	INT2
ATL	.499	.572	.616	.506
BOS	.432	.518	.350	.475
CHI	.449	.529	.445	.556
CLE	.432	.468	.128	.386
DAL/FTW	.410	.466	.426	.419
DEN	.494	.502	.565	.487
DTW	.391	.446	.191	.416
HNL	.595	.640	.365	.450
IAH	.478	.431	.424	.473
KAN	.403	.414	.705	.474
LAS	.416	.533	.405	.571
LOS ANG	.466	.469	.360	.518
MIA/FTL	.377	.456	.508	.542
MSP	.392	.462	.469	.400
MSY	.399	.482	.291	.356
NYC/NWK	.487	.535	.477	.518
PHL	.416	.450	.265	.423
PIT	.375	.460	.261	.483
STL	.403	.446	.337	.501
SFO/OAK	.430	.491	.409	.322
SJU	.603	.564	.332	.472
SEA/TAC	.374	.437	.312	.455
WAS/BLT	.447	.485	.453	.448
TPA	.353	.435	.567	.228
PHX	.440	.381	.400	.333

Table B-4

ACTUAL AVAIL L.H. CAPACITY (LBS/DEPT)
(SYS AVAIL= 8245.) (SYS AVAIL=13492.)

	DOM1	DOM2	INT1	INT2
ATL	10282.	5854.	6418.	3926.
BOS	10405.	5548.	22786.	10918.
CHI	13221.	7411.	36722.	12064.
CLE	8894.	5870.	60032.	7325.
DAL/FTW	9682.	7643.	12619.	11639.
DEN	11227.	6740.	7203.	5262.
DTW	12646.	7322.	23608.	5590.
HNL	11988.	4213.	22926.	31371.
IAH	13592.	7289.	7673.	5854.
KAN	6784.	6835.	7401.	10193.
LAS	6014.	7451.	4879.	5434.
LOS ANG	17080.	9153.	32340.	11272.
MIA/FTL	13805.	8097.	9712.	8127.
MSP	13090.	7754.	15383.	14870.
MSY	8539.	6823.	7497.	5274.
NYC/NWK	11971.	6622.	23789.	13618.
PHL	11238.	5763.	16800.	7138.
PIT	6192.	4404.	4804.	7434.
STL	7147.	5117.	11214.	5108.
SFO/OAK	14239.	7841.	45408.	12604.
SJU	20757.	9722.	8510.	6433.
SEA/TAC	19660.	10236.	39475.	10608.
WAS/BLT	7554.	4748.	23294.	6645.
TPA	10156.	8277.	8749.	10126.
PHX	10459.	6712.	6315.	5173.

Table B-5

ACTUAL ENPL L.H. LOAD FACTORS
(SYS= .185) (SYS= .269)

	DOM1	DOM2	INT1	INT2
ATL	.269	.171	.492	.196
BOS	.209	.135	.120	.185
CHI	.223	.188	.447	.286
CLE	.268	.200	.191	.068
DAL/FTW	.168	.132	.180	.011
DEN	.197	.126	.461	.139
DTW	.190	.168	.180	.188
HNL	.217	.289	.477	.114
IAH	.199	.120	.512	.111
KAN	.228	.141	.019	.030
LAS	.068	.020	.021	.002
LOS ANG	.266	.210	.263	.224
MIA/FTL	.190	.125	.498	.234
MSP	.225	.159	.321	.221
MSY	.144	.101	.457	.285
NYC/NWK	.208	.194	.462	.266
PHL	.205	.178	.081	.185
PIT	.185	.143	.157	.116
STL	.177	.153	.087	.007
SFO/OAK	.233	.208	.310	.200
SJU	.193	.133	.433	.218
SEA/TAC	.453	.139	.233	.173
WAS/BLT	.212	.145	.311	.158
TPA	.108	.092	.093	.004
PHX	.144	.062	.161	.012

Table B-6

ACTUAL FREIGHTER SIZE (TONS/DEPT)

	(SYS=38.54) DOM1	DOM2	(SYS=41.79) INT1	INT2
ATL	29.	26.	0.	0.
BOS	42.	38.	40.	37.
CHI	38.	38.	45.	45.
CLE	45.	44.	0.	0.
DAL/FTW	29.	20.	0.	0.
DEN	29.	22.	0.	0.
DTW	42.	26.	38.	32.
HNL	19.	14.	37.	38.
IAH	37.	22.	0.	0.
KAN	38.	38.	38.	0.
LAS	0.	38.	0.	0.
LOS ANG	41.	41.	38.	38.
MIA/FTL	39.	27.	39.	37.
MSP	35.	20.	36.	0.
MSY	47.	0.	0.	0.
NYC/NWK	41.	43.	46.	40.
PHL	38.	50.	38.	0.
PIT	38.	38.	0.	0.
STL	38.	38.	38.	38.
SFO/OAK	43.	41.	39.	43.
SJU	40.	0.	62.	0.
SEA/TAC	39.	49.	41.	45.
WAS/BLT	38.	38.	36.	0.
TPA	0.	0.	0.	0.
PHX	0.	0.	0.	0.

Table B-7

ACTUAL FREIGHTER ENPL LOAD FACTORS

	(SYS= .416) DOM1	DOM2	(SYS= .586) INT1	INT2
ATL	.335	.075	.000	.000
BOS	.446	.144	.355	.233
CHI	.400	.262	.542	.377
CLE	.391	.058	.000	.000
DAL/FTW	.313	.206	.000	.000
DEN	.294	.419	.000	.000
DTW	.365	.543	.435	.197
HNL	.390	.608	.536	.116
IAH	.535	.630	.000	.000
KAN	.269	.285	.168	.000
LAS	.000	.287	.000	.000
LOS ANG	.457	.538	.274	.221
MIA/FTL	.576	.450	.798	.494
MSP	.501	.636	.003	.000
MSY	.126	.000	.000	.000
NYC/NWK	.507	.297	.639	.581
PHL	.310	.314	.186	.000
PIT	.579	.011	.000	.000
STL	.283	.359	.468	.410
SFO/OAK	.478	.322	.650	.425
SJU	.442	.000	.341	.000
SEA/TAC	.385	.272	.434	.512
WAS/BLT	.449	.173	.354	.000
TPA	.000	.000	.000	.000
PHX	.000	.000	.000	.000

Table B-8

PROJECTED AV. AVAIL SEATS PER DEPT-1977

	DOM1 (SYS=130)	DOM2 (SYS=175)	INT1 (SYS=175)	INT2 (SYS=175)
ATL	149	118	147	128
BOS	146	114	230	156
CHI	162	121	331	155
CLE	130	116	241	129
DAL/FTW	138	123	151	161
DEN	138	115	131	111
DTW	151	119	228	116
HNL	177	143	215	296
IAH	146	124	111	120
KAN	113	113	137	141
LAS	116	130	111	119
LOS ANG	185	135	300	170
MIA/FTL	166	138	161	148
MSP	144	121	118	153
MSY	130	124	133	147
NYC/NWK	158	124	243	181
PHL	148	116	195	136
PIT	115	103	122	133
STL	119	105	143	144
SFO/OAK	175	131	318	181
SJU	248	164	145	137
SEA/TAC	190	139	360	159
WAS/BLT	124	108	244	132
TPA	140	137	131	157
PHX	138	117	129	116

Table B-9

PROJECTED HUB PAX ENPL LOAD FACTORS-1977

	DOM1 (SYS= .480)	DOM2 (SYS= .480)	INT1 (SYS= .480)	INT2 (SYS= .480)
ATL	.502	.575	.629	.523
BOS	.436	.522	.372	.492
CHI	.453	.532	.464	.571
CLE	.436	.472	.157	.406
DAL/FTW	.414	.469	.445	.438
DEN	.498	.506	.580	.504
DTW	.395	.450	.217	.435
HNL	.598	.642	.386	.468
IAH	.482	.435	.443	.490
KAN	.408	.418	.715	.491
LAS	.420	.537	.425	.585
LOS ANG	.470	.473	.381	.534
MIA/FTL	.381	.460	.524	.557
MSP	.396	.466	.486	.420
MSY	.403	.486	.314	.377
NYC/NWK	.491	.538	.494	.534
PHL	.420	.454	.289	.442
PIT	.379	.464	.285	.500
STL	.407	.450	.358	.517
SFO/OAK	.434	.494	.428	.344
SJU	.606	.567	.354	.490
SEA/TAC	.379	.441	.335	.473
WAS/BLT	.451	.489	.471	.466
TPA	.357	.439	.581	.253
PHX	.444	.386	.420	.355

Table B-10

1977 PROJECTED L.H. "USEABLE" CAPACITY (LBS/DEPT)

	(SYS AVAIL= 9800.) DOM1	DOM2	(SYS AVAIL=15000.) INT1	INT2
ATL	3318.	1403.	4249.	1359.
BOS	2658.	1088.	3748.	2756.
CHI	3460.	1830.	17438.	4314.
CLE	2936.	1618.	13333.	981.
DAL/FTW	2049.	1369.	3032.	699.
DEN	2674.	1186.	4363.	1256.
DTW	2866.	1635.	5291.	1662.
HNL	3092.	1801.	11955.	4837.
IAH	3185.	1210.	5041.	1149.
KAN	2035.	1325.	557.	841.
LAS	652.	342.	420.	323.
LOS ANG	5098.	2400.	9678.	3310.
MIA/FTL	3096.	1368.	5917.	2638.
MSP	3452.	1629.	5878.	4134.
MSY	1615.	991.	4463.	2265.
NYC/NWK	2979.	1725.	12007.	4493.
PHL	2781.	1434.	2172.	1962.
PIT	1570.	975.	1294.	1417.
STL	1681.	1153.	1614.	342.
SFO/OAK	3843.	2101.	15387.	3308.
SJU	4519.	1669.	4691.	2079.
SEA/TAC	9591.	1813.	10535.	2549.
WAS/BLT	2068.	1042.	8273.	1638.
TPA	1451.	1067.	1378.	535.
PHX	1905.	661.	1603.	381.

Table B-11

PROJECTED ENPL L.H. LOAD FACTORS-1977

	(SYS= .200) DOM1	DOM2	(SYS= .300) INT1	INT2
ATL	.283	.187	.514	.230
BOS	.224	.151	.157	.220
CHI	.238	.203	.470	.316
CLE	.282	.215	.225	.107
DAL/FTW	.183	.148	.214	.053
DEN	.211	.142	.484	.175
DTW	.205	.183	.215	.222
HNL	.231	.303	.499	.151
IAH	.214	.136	.532	.149
KAN	.242	.157	.060	.071
LAS	.085	.038	.062	.044
LOS ANG	.280	.225	.294	.257
MIA/FTL	.205	.142	.519	.266
MSP	.239	.175	.350	.253
MSY	.160	.117	.480	.315
NYC/NWK	.223	.209	.484	.297
PHL	.220	.193	.120	.219
PIT	.200	.159	.192	.153
STL	.192	.169	.126	.049
SFO/OAK	.248	.223	.339	.234
SJU	.208	.149	.457	.251
SEA/TAC	.464	.155	.265	.208
WAS/BLT	.226	.161	.340	.193
TPA	.125	.109	.131	.045
PHX	.160	.079	.196	.054

Table B-12

PROJECTED FREIGHTER SIZE (TONS/DEPT)-1977

	DOM1 (SYS=40.00)	DOM2 (SYS=40.00)	INT1 (SYS=43.00)	INT2 (SYS=43.00)
ATL	32.	30.	0.	0.
BOS	42.	39.	42.	38.
CHI	40.	39.	46.	46.
CLE	45.	44.	0.	0.
DAL/FTW	33.	26.	0.	0.
DEN	33.	27.	0.	0.
DTW	43.	30.	40.	33.
HNL	25.	21.	38.	39.
IAH	39.	27.	0.	0.
KAN	39.	39.	39.	0.
LAS	0.	40.	0.	0.
LOS ANG	42.	42.	39.	40.
MIA/FTL	40.	31.	40.	39.
MSP	37.	26.	38.	0.
MSY	47.	0.	0.	0.
NYC/NWK	42.	43.	47.	41.
PHL	40.	49.	39.	0.
PIT	39.	40.	0.	0.
STL	39.	39.	39.	39.
SFO/OAK	44.	42.	40.	44.
SJU	41.	0.	63.	0.
SEA/TAC	40.	48.	42.	46.
WAS/BLT	40.	40.	37.	0.
TPA	0.	0.	0.	0.
PHX	0.	0.	0.	0.

Table B-13

PROJECTED FRTR ENPL LOAD FACTORS-1977

	DOM1 (SYS= .440)	DOM2 (SYS= .440)	INT1 (SYS= .610)	INT2 (SYS= .610)
ATL	.362	.113	.000	.000
BOS	.469	.180	.393	.278
CHI	.425	.292	.569	.413
CLE	.416	.097	.000	.000
DAL/FTW	.342	.239.	.000	.000
DEN	.323	.443	.000	.000
DTW	.391	.562	.468	.244
HNL	.416	.625	.563	.167
IAH	.554	.645	.000	.000
KAN	.299	.315	.217	.000
LAS	.000	.317	.000	.000
LOS ANG	.479	.557	.316	.267
MIA/FTL	.594	.473	.809	.524
MSP	.522	.651	.061	.000
MSY	.163	.000	.000	.000
NYC/NWK	.527	.326	.660	.606
PHL	.339	.342	.234	.000
PIT	.597	.052	.000	.000
STL	.312	.386	.499	.444
SFO/OAK	.499	.350	.670	.459
SJU	.465	.000	.379	.000
SEA/TAC	.410	.303	.466	.540
WAS/BLT	.472	.207	.392	.000
TPA	.000	.000	.000	.000
PHX	.000	.000	.000	.000

Table B-14

DEMAND INPUT-1977

	ANNUAL ENPL PAX(000) DOM	INT	ANNUAL ENPL CARGO(TONS) DOM	INT
ATL	14210	100	169734	2126
BOS	5907	556	102869	27196
CHI	18782	1263	484569	104195
CLE	3420	17	76153	5148
DAL/FTW	8573	202	119659	2238
DEN	6126	93	81368	1343
DTW	4609	192	130372	24398
HNL	4076	1064	62218	13430
IAH	3454	342	58644	16116
KAN	2453	17	46059	4477
LAS	3210	19	5497	112
LOS ANG	14812	1682	412264	71852
MIA/FTL	7195	2065	103007	148627
MSP	3841	90	80024	2238
MSY	2623	75	25858	5484
NYC/NWK	18606	5747	479384	444851
PHL	3978	365	93521	10296
PIT	4260	65	45544	560
STL	4142	17	60110	224
SFO/OAK	11076	910	260100	42417
SJU	2064	577	45506	9625
SEA/TAC	3025	344	113616	7498
WAS/BLT	9158	502	124900	7275
TPA	2959	24	26321	783
PHX	2363	29	22323	112

Table B-15

PAX DEMAND MARKET SPLIT (000)-1977

	DOM1	DOM2	INT1	INT2
ATL	4597	9613	41	59
BOS	1883	4024	108	448
CHI	5742	13040	184	1079
CLE	843	2577	1	16
DAL/FTW	2895	5678	124	78
DEN	2592	3534	85	8
DTW	1564	3045	43	149
HNL	2795	1281	325	739
IAH	922	2532	84	258
KAN	837	1616	2	15
LAS	492	2718	14	5
LOS ANG	6508	8304	732	950
MIA/FTL	1509	5686	346	1719
MSP	1101	2740	16	74
MSY	1162	1461	10	65
NYC/NWK	6331	12275	1683	4064
PHL	1336	2642	121	244
PIT	1800	2460	46	19
STL	1659	2483	8	9
SFO/OAK	2810	8266	376	534
SJU	1377	687	140	537
SEA/TAC	743	2282	68	276
WAS/BLT	3992	5166	211	291
TPA	1158	1801	8	16
PHX	1133	1230	7	22

Table B-16

CARGO DEMAND MARKET SPLIT (TONS)-1977

	DOM1	DOM2	INT1	INT2
ATL	99616	70118	1442	684
BOS	75598	27271	14466	12730
CHI	320897	163672	77684	26511
CLE	45259	30894	4173	975
DAL/FTW	66561	53098	2168	70
DEN	51435	29933	1307	36
DTW	90137	40235	19798	4600
HNL	49786	12432	11349	2081
IAH	36287	22357	11734	4382
KAN	22676	23383	4091	386
LAS	2320	3177	109	3
LOS ANG	313459	98805	51159	20693
MIA/FTL	52985	50022	118136	30491
MSP	43881	36143	740	1498
MSY	16570	9288	1925	3559
NYC/NWK	334788	144596	329759	115092
PHL	62204	31317	6536	3760
PIT	26865	18679	453	107
STL	35165	24945	222	2
SFO/OAK	158534	101566	37684	4733
SJU	40340	5166	4696	4929
SEA/TAC	75086	38530	5772	1726
WAS/BLT	81768	43132	5623	1652
TPA	14028	12293	660	123
PHX	15813	6510	89	23

Table B-17

1977

PROJECTED NO OF PAX FLIGHTS (ACTUAL NO OF FLIGHTS APR 74 - MAR 75)

	(SYS PAX L.F.= .480) (SYS SEATS/DEPT=130)		(SYS PAX L.F.= .480) (SYS SEATS/DEPT=175)			
	DOM1	DOM2	INT1		INT2	
			**	*	**	*
ATL	61225(57526)	141903(138000)	443(403)		879(834)	
BOS	29663(24108)	67495(56851)	1265(955)		5836(4527)	
CHI	78167(70650)	203029(191012)	1201(409)		12183(4444)	
CLE	14875(13182)	47176(42583)	26(8)		306(103)	
DAL/FTW	50583(45112)	98070(88832)	1842(1590)		1105(940)	
DEN	37781(35568)	60942(59094)	1123(886)		143(116)	
DTW	26141(22283)	57039(50328)	870(519)		2953(1819)	
HNL	26376(24939)	13950(13534)	3914(1199)		5327(1560)	
IAH	13086(11296)	46923(41566)	1707(517)		4399(1293)	
KAN	18127(17667)	34164(33281)	201 9)		216(88)	
LAS	10080(8608)	39100(32693)	298(302)		72(67)	
LOS ANG	74813(45580)	130164(82518)	6405(2050)		10451(3460)	
MIA/FTL	23885(19874)	89911(76436)	4100(1604)		20862(8245)	
MSP	19237(17118)	48461(44178)	279(285)		1155(1102)	
MSY	22190(19309)	24272(21231)	239(110)		1171(519)	
NYC/NWK	81623(67251)	184195(156970)	14008(4907)		42119(15178)	
PHL	21449(19087)	50215(46372)	2147(684)		4058(1310)	
PIT	41110(38322)	51476(48900)	1319(770)		286(160)	
STL	34375(33002)	52494(51449)	156(75)		121(51)	
SFO/OAK	37064(21758)	128070(77982)	2760(821)		8563(2756)	
SJU	9154(7647)	7405(6442)	2719(1078)		7995(3125)	
SEA/TAC	10299(9501)	37131(35447)	563(326)		3682(2254)	
WAS/BLT	71106(64489)	98097(91175)	1838(960)		4721(2688)	
TPA	23163(19830)	29873(25538)	105(91)		402(396)	
PHX	18525(16897)	27219(25550)	130(108)		536(444)	

* U.S. FLAG CARRIERS ONLY
** INCLUDES FOREIGN FLAG ACTIVITY

Table B-18

1977 PROJECTED TOTAL
L.H. "USEABLE" CAPACITY (TONS)

	DOM1	DOM2	INT1 **	INT2 **
ATL	101565.	99546.	941.	597.
BOS	39425.	36732.	2370.	8043.
CHI	135248.	185822.	10472.	26278.
CLE	21835.	38161.	173.	150.
DAL/FTW	51811.	67137.	2793.	386.
DEN	50506.	36132.	2450.	90.
DTW	37461.	46630.	2301.	2454.
HNL	40783.	12562.	23396.	12884.
IAH	20842.	28391.	4303.	2527.
KAN	18446.	22639.	6.	91.
LAS	3284.	6678.	63.	12.
LOS ANG	190695.	156179.	30993.	17298.
MIA/FTL	36977.	61477.	12130.	27513.
MSP	33199.	39469.	820.	2387.
MSY	17914.	12026.	533.	1326.
NYC/NWK	121586.	158829.	84094.	94611.
PHL	29821.	35995.	2332.	3981.
PIT	32268.	25102.	853.	203.
STL	28900.	30266.	126.	21.
SFO/OAK	71226.	134546.	21234.	14162.
SJU	20684.	6180.	6377.	8312.
SEA/TAC	49390.	33668.	2966.	4693.
WAS/BLT	73527.	51132.	7603.	3867.
TPA	16800.	15942.	72.	108.
PHX	17642.	8996.	104.	102.

** INCLUDES FOREIGN FLAG ACTIVITY

Table B-19

1977
PROJECTED NO OF FRTR FLIGHTS (ACTUAL NO OF FLIGHTS APR 74 - MAR 75)
(SYS FRTR L.F.= .440) (SYS FRTR L.F.= .610)
(SYS TONS/DEPT= 40.0) (SYS TONS/DEPT= 43.0)

	DOM1	DOM2	INT1		INT2	
			**	*	**	*
ATL	0(1871)	0(218)	19(0)		3(0)	
BOS	1820(1756)	0(103)	739(273)		444(1)	
CHI	10932(11334)	0(987)	2567(882)		12(42)	
CLE	1241(1188)	0(135)	152(0)		31(0)	
DAL/FTW	1307(2222)	0(261)	0(0)		0(0)	
DEN	88(434)	0(33)	0(0)		0(0)	
DTW	3145(2975)	0(128)	941(184)		267(3)	
HNL	872(1911)	0(405)	0(444)		0(40)	
IAH	717(775)	0(86)	283(0)		71(0)	
KAN	360(359)	60(183)	485(23)		11(0)	
LAS	0(0)	0(2)	2(0)		0(0)	
LOS ANG	6094(8340)	0(133)	1623(213)		321(15)	
MIA/FTL	671(693)	0(261)	3258(975)		148(53)	
MSP	550(532)	0(164)	0(1)		0(0)	
MSY	0(140)	0(0)	53(0)		85(0)	
NYC/NWK	9638(9515)	0(1654)	7975(2350)		828(260)	
PHL	2418(2357)	0(97)	459(148)		0(0)	
PIT	0(2)	0(2)	0(0)		0(0)	
STL	510(700)	0(3)	5(4)		0(0)	
SFO/OAK	4018(4752)	0(1745)	609(933)		0(28)	
SJU	1024(955)	0(0)	0(2)		0(0)	
SEA/TAC	1548(1305)	333(520)	142(315)		0(2)	
WAS/BLT	440(487)	0(77)	0(104)		0(0)	
TPA	0(0)	0(0)	22(0)		1(0)	
PHX	0(0)	0(0)	0(0)		0(0)	

* U.S. FLAG CARRIERS ONLY
** INCLUDES FOREIGN FLAG ACTIVITY

Table B-20

PROJECTED AV. AVAIL SEATS PER DEPT-1982

(SYS=150) (SYS=195)

	DOM1	DOM2	INT1	INT2
ATL	168	139	170	154
BOS	164	136	244	178
CHI	179	141	334	177
CLE	150	137	254	154
DAL/FTW	157	144	174	183
DEN	157	136	155	138
DTW	169	140	242	142
HNL	193	162	231	303
IAH	165	145	138	146
KAN	135	135	161	165
LAS	137	150	138	145
LOS ANG	200	154	306	191
MIA/FTL	183	157	183	171
MSP	163	142	144	175
MSY	150	144	158	170
NYC/NWK	176	144	256	200
PHL	167	137	213	160
PIT	137	125	148	158
STL	140	127	167	167
SFO/OAK	191	151	323	201
SJU	258	181	169	161
SEA/TAC	205	159	360	180
WAS/BLT	145	130	256	157
TPA	159	157	156	179
PHX	157	138	154	142

Table B-21

PROJECTED HUB PAX ENPL LOAD FACTORS-1982

(SYS= .500) (SYS= .500)

	DOM1	DOM2	INT1	INT2
ATL	.521	.591	.643	.541
BOS	.458	.540	.396	.512
CHI	.474	.550	.484	.587
CLE	.458	.492	.190	.429
DAL/FTW	.437	.490	.466	.460
DEN	.517	.525	.596	.523
DTW	.418	.471	.247	.457
HNL	.613	.656	.409	.489
IAH	.502	.457	.464	.510
KAN	.430	.440	.726	.511
LAS	.443	.555	.447	.601
LOS ANG	.490	.493	.405	.552
MIA/FTL	.405	.480	.543	.574
MSP	.420	.487	.506	.442
MSY	.426	.506	.341	.401
NYC/NWK	.511	.556	.514	.552
PHL	.442	.475	.317	.464
PIT	.403	.485	.313	.519
STL	.430	.471	.383	.536
SFO/OAK	.456	.514	.450	.369
SJU	.621	.583	.379	.509
SEA/TAC	.403	.462	.361	.493
WAS/BLT	.472	.508	.492	.487
TPA	.382	.460	.598	.282
PHX	.465	.409	.442	.379

Table B-22

1982 PROJECTED
L.H. "USEABLE" CAPACITY (LBS/DEPT)

	DOM1 (SYS AVAIL=12640.)	DOM2	INT1 (SYS AVAIL=18360.)	INT2
ATL	4329.	2184.	6803.	2940.
BOS	3534.	1768.	5690.	4458.
CHI	4359.	2658.	19256.	6263.
CLE	3957.	2477.	16124.	2252.
DAL/FTW	2829.	2055.	4760.	2023.
DEN	3520.	1848.	6802.	2675.
DTW	3698.	2410.	7280.	3250.
HNL	3981.	2921.	14056.	7073.
IAH	4035.	1861.	7619.	2497.
KAN	2967.	2028.	1687.	2138.
LAS	1152.	737.	1429.	1300.
LOS ANG	6050.	3280.	11783.	5110.
MIA/FTL	3929.	2039.	8396.	4414.
MSP	4353.	2383.	7907.	5987.
MSY	2335.	1589.	6885.	4166.
NYC/NWK	3850.	2567.	14083.	6413.
PHL	3645.	2232.	3859.	3576.
PIT	2389.	1672.	2758.	2834.
STL	2480.	1883.	3093.	1318.
SFO/OAK	4757.	2980.	17474.	5079.
SJU	5355.	2368.	7024.	3780.
SEA/TAC	10766.	2530.	12781.	4214.
WAS/BLT	2955.	1748.	10304.	3157.
TPA	2096.	1656.	2778.	1762.
PHX	2634.	1155.	3123.	1378.

Table B-23

PROJECTED ENPL L.H. LOAD FACTORS-1982

	DOM1 (SYS= .220)	DOM2	INT1 (SYS= .350)	INT2
ATL	.300	.207	.548	.285
BOS	.243	.172	.217	.275
CHI	.257	.223	.508	.365
CLE	.300	.234	.280	.171
DAL/FTW	.204	.170	.270	.120
DEN	.231	.163	.521	.234
DTW	.225	.204	.271	.278
HNL	.250	.320	.534	.212
IAH	.233	.158	.566	.209
KAN	.261	.178	.128	.137
LAS	.108	.062	.129	.112
LOS ANG	.298	.244	.344	.310
MIA/FTL	.225	.163	.553	.319
MSP	.258	.195	.396	.307
MSY	.181	.139	.517	.364
NYC/NWK	.242	.229	.521	.347
PHL	.239	.213	.183	.275
PIT	.220	.180	.250	.214
STL	.212	.190	.188	.117
SFO/OAK	.266	.242	.386	.288
SJU	.228	.170	.496	.304
SEA/TAC	.477	.176	.318	.264
WAS/BLT	.245	.182	.387	.251
TPA	.147	.131	.193	.113
PHX	.181	.102	.253	.121

Table B-24

PROJECTED FREIGHTER SIZE (TONS/DEPT)-1982

	DOM1 (SYS=42.00)	DOM2 (SYS=42.00)	INT1 (SYS=48.00)	INT2 (SYS=48.00)
ATL	37.	36.	0.	0.
BOS	43.	42.	47.	43.
CHI	42.	42.	51.	51.
CLE	45.	44.	0.	0.
DAL/FTW	38.	33.	0.	0.
DEN	38.	34.	0.	0.
DTW	44.	36.	45.	39.
HNL	33.	31.	44.	44.
IAH	41.	34.	0.	0.
KAN	42.	42.	44.	0.
LAS	0.	42.	0.	0.
LOS ANG	43.	43.	45.	45.
MIA/FTL	42.	37.	45.	44.
MSP	40.	34.	43.	0.
MSY	46.	0.	0.	0.
NYC/NWK	43.	44.	51.	46.
PHL	42.	47.	45.	0.
PIT	42.	42.	0.	0.
STL	42.	42.	44.	44.
SFO/OAK	44.	43.	46.	49.
SJU	43.	0.	66.	0.
SEA/TAC	42.	47.	47.	51.
WAS/BLT	42.	42.	42.	0.
TPA	0.	0.	0.	0.
PHX	0.	0.	0.	0.

Table B-25

PROJECTED FRTR ENPL LOAD FACTORS-1982

	DOM1 (SYS= .480)	DOM2 (SYS= .480)	INT1 (SYS= .630)	INT2 (SYS= .630)
ATL	.408	.176	.000	.000
BOS	.507	.239	.424	.315
CHI	.466	.343	.591	.443
CLE	.458	.162	.000	.000
DAL/FTW	.389	.293	.000	.000
DEN	.372	.483	.000	.000
DTW	.435	.594	.495	.282
HNL	.458	.652	.585	.210
IAH	.586	.671	.000	.000
KAN	.349	.364	.257	.000
LAS	.000	.366	.000	.000
LOS ANG	.516	.589	.351	.304
MIA/FTL	.623	.510	.819	.548
MSP	.556	.676	.109	.000
MSY	.223	.000	.000	.000
NYC/NWK	.561	.374	.677	.626
PHL	.386	.389	.273	.000
PIT	.626	.120	.000	.000
STL	.362	.430	.525	.473
SFO/OAK	.535	.397	.687	.486
SJU	.504	.000	.411	.000
SEA/TAC	.452	.353	.494	.564
WAS/BLT	.510	.264	.423	.000
TPA	.000	.000	.000	.000
PHX	.000	.000	.000	.000

Table B-26

DEMAND INPUT=1982

	ANNUAL ENPL PAX(000)		ANNUAL ENPL CARGO(TONS)	
	DOM	INT	DOM	INT
ATL	18765	132	211755	3154
BOS	7801	734	125915	40333
CHI	21929	1667	605841	154526
CLE	4516	23	94724	7635
DAL/FTW	11178	263	145109	3320
DEN	8090	123	100354	1992
DTW	6515	271	161815	36183
HNL	5381	1404	86012	19017
IAH	4560	451	78828	23901
KAN	3375	23	54347	6639
LAS	4370	26	6581	165
LOS ANG	19559	2221	520625	106558
MIA/FTL	9499	2726	129289	220419
MSP	5071	119	96857	3320
MSY	3463	99	31344	8133
NYC/NWK	24567	7589	591320	655282
PHL	5253	481	113567	15270
PIT	5623	85	54490	830
STL	6008	24	71349	332
SFO/OAK	14613	1201	327067	62906
SJU	2725	893	57856	14274
SEA/TAC	3993	453	142062	11120
WAS/BLT	11193	614	142325	10788
TPA	3905	31	31643	1162
PHX	3083	37	27191	166

Table B-27

PAX DEMAND MARKET SPLIT (000)-1982

	DOM1	DOM2	INT1	INT2
ATL	5071	12694	54	78
BOS	2486	5315	142	592
CHI	6705	15224	242	1425
CLE	1113	3403	1	22
DAL/FTW	3775	7403	162	101
DEN	3423	4667	113	10
DTW	2211	4304	60	211
HNL	3690	1691	428	976
IAH	1218	3342	111	340
KAN	1152	2223	3	20
LAS	869	3701	19	7
LOS ANG	8593	10966	966	1255
MIA/FTL	1992	7507	457	2269
MSP	1453	3518	22	97
MSY	1534	1929	13	86
NYC/NWK	8359	16208	2222	5367
PHL	1764	3489	159	322
PIT	2375	3248	60	25
STL	2406	3602	12	12
SFO/OAK	3707	10306	496	705
SJU	1818	907	184	709
SEA/TAC	981	3012	89	364
WAS/BLT	4879	6314	258	356
TPA	1528	2377	10	21
PHX	1478	1605	9	28

Table B-28

CARGO DEMAND MARKET SPLIT (TONS)-1982

	DOM1	DOM2	INT1	INT2
ATL	124278	87477	2140	1014
BOS	92534	33381	21454	18879
CHI	401207	204634	115209	39317
CLE	56296	38428	6189	1446
DAL/FTW	80717	64392	3216	104
DEN	63437	36917	1939	53
DTW	111876	49939	29360	6823
HNL	68826	17186	16070	2947
IAH	48776	30052	17402	6499
KAN	26757	27590	6066	573
LAS	2778	3803	161	4
LOS ANG	395850	124775	75869	30689
MIA/FTL	66504	62785	175199	45220
MSP	53112	43745	1098	2222
MSY	20085	11259	2855	5278
NYC/NWK	412961	178359	485748	169534
PHL	75538	38029	9694	5576
PIT	32142	22348	671	159
STL	41740	29609	329	3
SFO/OAK	199351	127716	55886	7020
SJU	51287	6569	6965	7309
SEA/TAC	93885	48177	8560	2560
WAS/BLT	93176	49149	8338	2450
TPA	16865	14778	980	182
PHX	19262	7929	132	34

Table B-29

1982
PROJECTED NO OF PAX FLIGHTS (ACTUAL NO OF FLIGHTS APR 74 - MAR 75)

	DOM1 (SYS PAX L.F.= .500) (SYS SEATS/DEPT=150)	DOM2 (SYS PAX L.F.= .500) (SYS SEATS/DEPT=195)	INT1		INT2	
			**	*	**	*
ATL	69396(57526)	154592(138000)	493(403)		939(834)	
BOS	33075(24108)	72553(56851)	1471(955)		6497(4527)	
CHI	78567(70650)	195566(191012)	1498(409)		13683(4444)	
CLE	15215(13182)	50474(42583)	21(8)		334(103)	
DAL/FTW	54900(45112)	105024(88832)	1998(1590)		1203(940)	
DEN	42127(35568)	65395(59094)	1220(886)		138(116)	
DTW	31170(22283)	65432(50328)	1002(519)		3244(1819)	
HNL	31152(24939)	15927(13534)	4527(1199)		6587(1560)	
IAH	14729(11296)	50624(41566)	1732(517)		4579(1293)	
KAN	19867(17667)	37499(33281)	26(9)		237(88)	
LAS	11007(8608)	44628(32693)	309(302)		80(67)	
LOS ANG	87497(45580)	143950(82518)	7785(2050)		11919(3460)	
MIA/FTL	26935(19874)	99585(76436)	4615(1604)		23130(8245)	
MSP	21229(17118)	52336(44178)	302(285)		1253(1102)	
MSY	24019(19309)	26418(21231)	242(110)		1259(519)	
NYC/NAS	93272(67251)	201972(156970)	16911(4907)		48602(15178)	
PHL	23926(19087)	53570(46372)	2360(684)		4334(1310)	
PIT	43102(38322)	53469(48900)	1296(770)		306(160)	
STL	40110(33002)	60079(51449)	188(75)		134(51)	
SFO/OAK	42633(21758)	141042(77982)	3414(821)		9516(2756)	
SJU	11347(7647)	8601(6442)	2879(1078)		8631(3125)	
SEA/TAC	11874(9501)	41061(35447)	685(326)		4093(2254)	
WAS/BLT	71299(64489)	95775(91175)	2048(960)		4663(2688)	
TPA	25151(19830)	32942(25538)	108(91)		416(396)	
PHX	20222(16897)	28358(25550)	133(108)		519(444)	

* U.S. FLAG CARRIERS ONLY
** INCLUDES FOREIGN FLAG ACTIVITY

Table B-30

1982 PROJECTED TOTAL
L.H. "USEABLE" CAPACITY (TONS)

	DOM1	DOM2	INT1 **	INT2 **
ATL	150212.	108812.	1677.	1380.
BOS	58150.	64124.	4185.	14482.
CHI	171877.	259924.	14423.	42848.
CLE	32079.	62509.	169.	376.
DAL/FTW	77668.	107901.	4756.	1217.
DEN	74147.	60430.	4149.	185.
DTW	57631.	78853.	3647.	5272.
HNL	62004.	23259.	31817.	23293.
IAH	29716.	47115.	6598.	5717.
KAN	29469.	38031.	22.	253.
LAS	6342.	16454.	221.	52.
LOS ANG	264657.	236111.	45867.	30454.
MIA/FTL	52309.	101502.	19374.	51048.
MSP	46205.	62347.	1194.	3751.
MSY	28041.	20984.	833.	2623.
NYC/NWK	179552.	259275.	119076.	155842.
PHL	43610.	59783.	4554.	7748.
PIT	51480.	44710.	1787.	434.
STL	49727.	56561.	291.	88.
SFO/OAK	101394.	210148.	29828.	24165.
SJU	30383.	10185.	10111.	16312.
SEA/TAC	63917.	51967.	4378.	8624.
WAS/BLT	105360.	83705.	10551.	7360.
TPA	26364.	27281.	150.	367.
PHX	26628.	16381.	208.	357.

** INCLUDES FOREIGN FLAG ACTIVITY

Table B-31

1982

PROJECTED NO OF FRTR FLIGHTS (ACTUAL NO OF FLIGHTS APR 74 - MAR 75)

	(SYS FRTR L.F.= .480) (SYS TONS/DEPT= 42.0)		(SYS FRTR L.F.= .630) (SYS TONS/DEPT= 48.0)	
	DOM1	DOM2	INT1	INT2
			** *	** *
ATL	0(1871)	0(218)	15(0)	0(0)
BOS	1548(1756)	0(103)	871(273)	322(1)
CHI	11718(11334)	0(987)	3359(882)	0(42)
CLE	1170(1188)	0(135)	199(0)	35(0)
DAL/FTW	207(2222)	0(261)	0(0)	0(0)
DEN	0(434)	0(33)	0(0)	0(0)
DTW	2856(2975)	0(128)	1154(184)	141(3)
HNL	453(1911)	0(405)	0(444)	0(40)
IAH	787(775)	0(86)	357(0)	26(0)
KAN	0(359)	0(183)	532(23)	11(0)
LAS	0(0)	0(2)	0(0)	0(0)
LOS ANG	5877(8340)	0(133)	1915(213)	17(15)
MIA/FTL	518(693)	0(261)	4186(975)	0(53)
MSP	304(532)	0(164)	0(1)	0(0)
MSY	0(140)	0(0)	67(0)	88(0)
NYC/NWK	9636(9515)	0(1654)	10541(2350)	475(260)
PHL	1952(2357)	0(97)	423(148)	0(0)
PIT	0(2)	0(2)	0(0)	0(0)
STL	0(700)	0(3)	2(4)	0(0)
SFO/OAK	4149(4752)	0(1745)	833(933)	0(28)
SJU	971(955)	0(0)	0(2)	0(0)
SEA/TAC	1567(1305)	0(520)	179(315)	0(2)
WAS/BLT	0(487)	0(77)	0(104)	0(0)
TPA	0(0)	0(0)	27(0)	0(0)
PHX	0(0)	0(0)	0(0)	0(0)

* U.S. FLAG CARRIERS ONLY
** INCLUDES FOREIGN FLAG ACTIVITY

Table B-32

PROJECTED AV. AVAIL SEATS PER DEPT-1987

(SYS=170) (SYS=215)

	DOM1	DOM2	INT1	INT2
ATL	186	160	193	179
BOS	183	157	258	200
CHI	197	162	337	199
CLE	170	158	267	179
DAL/FTW	177	164	196	204
DEN	176	157	180	165
DTW	188	161	256	169
HNL	209	181	247	310
IAH	183	165	165	172
KAN	156	156	185	189
LAS	159	170	165	171
LOS ANG	216	174	313	211
MIA/FTL	199	176	204	194
MSP	182	163	170	197
MSY	170	165	182	193
NYC/NWK	193	165	268	220
PHL	185	158	231	184
PIT	158	148	174	182
STL	161	149	190	191
SFO/OAK	207	170	327	220
SJU	268	198	192	185
SEA/TAC	220	178	360	202
WAS/BLT	165	152	269	182
TPA	178	176	180	201
PHX	176	159	179	169

Table B-33

PROJECTED HUB PAX ENPL LOAD FACTORS-1987

(SYS= .520) (SYS= .520)

	DOM1	DOM2	INT1	INT2
ATL	.541	.607	.657	.559
BOS	.479	.558	.420	.531
CHI	.495	.568	.505	.604
CLE	.479	.512	.222	.452
DAL/FTW	.459	.510	.488	.481
DEN	.536	.544	.612	.542
DTW	.442	.492	.278	.479
HNL	.629	.670	.433	.509
IAH	.522	.478	.486	.529
KAN	.453	.463	.737	.530
LAS	.465	.572	.469	.617
LOS ANG	.511	.513	.429	.570
MIA/FTL	.429	.501	.561	.591
MSP	.443	.507	.526	.464
MSY	.449	.525	.367	.425
NYC/NWK	.530	.573	.533	.569
PHL	.464	.496	.344	.485
PIT	.427	.505	.340	.538
STL	.453	.492	.408	.554
SFO/OAK	.477	.533	.472	.395
SJU	.636	.600	.404	.529
SEA/TAC	.426	.484	.386	.513
WAS/BLT	.493	.528	.512	.507
TPA	.407	.482	.614	.311
PHX	.486	.433	.464	.404

Table B-34

1987 PROJECTED
L.H. "USEABLE" CAPACITY (LBS/DEPT)
(SYS AVAIL=15500.) (SYS AVAIL=21960.)

	DOM1	DOM2	INT1	INT2
ATL	5445.	3096.	9816.	5111.
BOS	4521.	2583.	7961.	6651.
CHI	5357.	3609.	21168.	8659.
CLE	5086.	3463.	18682.	4106.
DAL/FTW	3728.	2870.	6956.	3876.
DEN	4476.	2644.	9701.	4685.
DTW	4635.	3312.	9575.	5408.
HNL	4974.	4160.	16419.	9505.
IAH	4966.	2645.	10634.	4436.
KAN	4018.	2863.	3414.	3983.
LAS	1797.	1278.	3075.	2910.
LOS ANG	7085.	4276.	14056.	7386.
MIA/FTL	4863.	2838.	11293.	6708.
MSP	5355.	3262.	10328.	8265.
MSY	3180.	2323.	9763.	6610.
NYC/NWK	4827.	3535.	16412.	8764.
PHL	4619.	3160.	5976.	5737.
PIT	3335.	2509.	4815.	4817.
STL	3403.	2748.	5088.	2931.
SFO/OAK	5766.	3978.	19544.	7312.
SJU	6270.	3190.	9810.	6028.
SEA/TAC	12000.	3366.	15095.	6379.
WAS/BLT	3963.	2591.	12621.	5239.
TPA	2866.	2378.	4730.	3546.
PHX	3481.	1791.	5210.	3008.

Table B-35

PROJECTED ENPL L.H. LOAD FACTORS-1987
(SYS= .240) (SYS= .400)

	DOM1	DOM2	INT1	INT2
ATL	.318	.227	.583	.340
BOS	.263	.193	.277	.331
CHI	.276	.243	.546	.414
CLE	.318	.254	.336	.235
DAL/FTW	.224	.191	.326	.188
DEN	.251	.185	.557	.293
DTW	.244	.224	.327	.333
HNL	.270	.337	.570	.272
IAH	.253	.179	.599	.270
KAN	.280	.199	.195	.204
LAS	.131	.086	.196	.180
LOS ANG	.316	.264	.395	.363
MIA/FTL	.245	.184	.587	.371
MSP	.277	.216	.443	.360
MSY	.202	.161	.554	.413
NYC/NWK	.262	.249	.558	.397
PHL	.259	.233	.245	.330
PIT	.240	.201	.307	.274
STL	.233	.211	.251	.184
SFO/OAK	.285	.262	.434	.343
SJU	.247	.191	.535	.358
SEA/TAC	.490	.197	.370	.321
WAS/BLT	.265	.203	.434	.308
TPA	.169	.153	.255	.182
PHX	.202	.125	.311	.189

Table B-36

PROJECTED FREIGHTER SIZE (TONS/DEPT)-1987

	DOM1 (SYS=45.00)	DOM2 (SYS=45.00)	INT1 (SYS=54.00)	INT2 (SYS=54.00)
ATL	45.	45.	0.	0.
BOS	45.	45.	53.	50.
CHI	45.	45.	56.	56.
CLE	45.	45.	0.	0.
DAL/FTW	45.	45.	0.	0.
DEN	45.	45.	0.	0.
DTW	45.	45.	51.	46.
HNL	45.	45.	50.	51.
IAH	45.	45.	0.	0.
KAN	45.	45.	51.	0.
LAS	0.	45.	0.	0.
LOS ANG	45.	45.	51.	51.
MIA/FTL	45.	45.	52.	50.
MSP	45.	45.	50.	0.
MSY	45.	0.	0.	0.
NYC/NWK	45.	45.	57.	52.
PHL	45.	45.	51.	0.
PIT	45.	45.	0.	0.
STL	45.	45.	51.	51.
SFO/OAK	45.	45.	52.	55.
SJU	45.	0.	70.	0.
SEA/TAC	45.	45.	53.	57.
WAS/BLT	45.	45.	49.	0.
TPA	0.	0.	0.	0.
PHX	0.	0.	0.	0.

Table B-37

PROJECTED FRTR ENPL LOAD FACTORS-1987

	DOM1 (SYS= .520)	DOM2 (SYS= .520)	INT1 (SYS= .650)	INT2 (SYS= .650)
ATL	.454	.240	.000	.000
BOS	.545	.297	.455	.352
CHI	.508	.393	.613	.473
CLE	.500	.226	.000	.000
DAL/FTW	.436	.348	.000	.000
DEN	.420	.523	.000	.000
DTW	.478	.625	.522	.321
HNL	.499	.678	.608	.253
IAH	.618	.696	.000	.000
KAN	.400	.413	.297	.000
LAS	.000	.415	.000	.000
LOS ANG	.554	.621	.386	.342
MIA/FTL	.652	.548	.829	.572
MSP	.590	.701	.158	.000
MSY	.283	.000	.000	.000
NYC/NWK	.595	.423	.695	.646
PHL	.434	.436	.312	.000
PIT	.655	.188	.000	.000
STL	.411	.474	.550	.501
SFO/OAK	.571	.443	.704	.514
SJU	.542	.000	.443	.000
SEA/TAC	.495	.402	.521	.587
WAS/BLT	.547	.321	.454	.000
TPA	.000	.000	.000	.000
PHX	.000	.000	.000	.000

Table B-38

DEMAND INPUT-1967

	ANNUAL EMPL PAX(000) DOM	INT	ANNUAL EMPL CARGO(TONS) DOM	INT
ATL	25251	178	268179	4621
BOS	10497	987	157438	59097
CHI	33374	2243	768369	226415
CLE	6078	30	119727	11187
DAL/FTW	13977	329	180278	4864
DEN	10885	165	126114	2918
DTW	8156	339	204237	53017
HNL	7241	1890	101232	29184
IAH	5137	607	98308	35020
KAN	4629	32	65586	9728
LAS	5881	35	8103	243
LOS ANG	28321	2989	664628	156132
MIA/FTL	12783	3669	164392	322964
MSP	6825	150	120338	4864
MSY	4660	134	38928	11916
NYC/NWK	33062	10212	743233	960137
PHL	7069	648	141225	22374
PIT	7560	115	67057	1216
STL	8047	32	87310	486
SFO/OAK	19664	1517	415374	92171
SJU	3667	1203	74180	20915
SEA/TAC	5374	610	180184	16294
WAS/BLT	15765	779	168942	15808
TPA	5245	42	39074	1702
PHX	4199	51	33602	243

Table B-39

PAX DEMAND MARKET SPLIT (000)-1987

	DOM_1	DOM_2	INT_1	INT_2
ATL	8169	17082	73	105
BOS	3346	7151	191	796
CHI	10204	23170	326	1917
CLE	1498	4586	2	28
DAL/FTW	4720	9257	202	127
DEN	4606	6279	151	14
DTW	2758	5388	75	264
HNL	4966	2275	577	1313
IAH	1639	4498	150	457
KAN	1580	3049	4	28
LAS	901	4980	26	9
LOS ANG	11564	14757	1300	1689
MIA/FTL	2680	10103	615	3054
MSP	1956	4869	29	131
MSY	2064	2596	15	116
NYC/EWR	11249	21813	2990	7222
PHL	2374	4695	214	434
PIT	3194	4366	81	34
STL	3223	4824	16	16
SFO/OAK	4988	14676	667	950
SJU	2447	1220	248	955
SEA/TAC	1321	4053	120	490
WAS/BLT	6872	8893	327	452
TPA	2053	3192	13	29
PHX	2013	2186	13	38

Table B-40

CARGO DEMAND MARKET SPLIT (TONS)-1987

	DOM_1	DOM_2	INT_1	INT_2
ATL	157393	110786	3135	1486
BOS	115700	41738	31436	27601
CHI	508838	259531	168807	57608
CLE	71156	48571	9069	2118
DAL/FTW	100280	79998	4712	152
DEN	79720	46394	2840	78
DTW	141205	63032	43020	9997
HNL	81005	20227	24662	4522
IAH	60830	37478	25498	9522
KAN	32290	33296	8889	839
LAS	3420	4683	237	6
LOS ANG	505340	159288	111166	44966
MIA/FTL	84561	79831	256707	66257
MSP	65987	54351	1608	3256
MSY	24945	13983	4183	7733
NYC/EWR	519052	224181	711731	248406
PHL	93934	47291	14204	8170
PIT	39555	27502	983	233
STL	51077	36233	482	4
SFO/OAK	253784	162590	81886	10285
SJU	65758	8422	10205	10710
SEA/TAC	119079	61105	12543	3751
WAS/BLT	110601	58341	12217	3591
TPA	20825	18249	1436	266
PHX	23803	9799	193	50

Table B-41

1987

PROJECTED NO OF PAX FLIGHTS (ACTUAL NO OF FLIGHTS APR 74 - MAR 75)

	(SYS PAX L.F.= .520) (SYS SEATS/DEPT=170) DOM1	DOM2	(SYS PAX L.F.= .520) (SYS SEATS/DEPT=215) INT1 **	INT1 *	INT2 **	INT2 *
ATL	81217(57526)	175795(138000)	574(403)		1051(834)	
BOS	38174(24108)	81559(56851)	1763(955)		7488(4527)	
CHI	104876(70650)	251271(191012)	1917(409)		15917(4444)	
CLE	18387(13182)	56489(42583)	34(8)		347(103)	
DAL/FTW	58159(45112)	110311(88832)	2109(1590)		1293(940)	
DEN	48666(35568)	73395(59094)	1369(886)		156(116)	
DTW	33398(22283)	68153(50328)	1055(519)		3269(1819)	
HNL	37785(24939)	18796(13534)	5405(1199)		8317(1560)	
IAH	17131(11296)	56965(41566)	1872(517)		5030(1293)	
KAN	22326(17667)	42217(33281)	29(9)		280(88)	
LAS	12226(8608)	51310(32693)	337(302)		85(67)	
LOS ANG	105082(45580)	165154(82518)	9690(2050)		14029(3460)	
MIA/FTL	31332(19874)	114382(76436)	5374(1604)		26658(8245)	
MSP	24291(17118)	58969(44178)	324(285)		1429(1102)	
MSY	27057(19309)	29957(21231)	269(110)		1412(519)	
NYC/NWK	109895(67251)	230621(156970)	20894(4907)		57757(15178)	
PHL	27610(19087)	59782(46372)	2698(684)		4851(1310)	
PIT	47366(38322)	58510(48900)	1370(770)		347(160)	
STL	44355(33002)	65593(51449)	206(75)		151(51)	
SFO/OAK	50491(21758)	161488(77982)	4317(821)		10949(2756)	
SJU	14368(7647)	10278(6442)	3201(1078)		9741(3125)	
SEA/TAC	14083(9501)	47128(35447)	862(326)		4722(2254)	
WAS/BLT	84235(64489)	111094(91175)	2376(960)		4911(2688)	
TPA	28334(19830)	37616(25538)	117(91)		464(396)	
PHX	23450(16897)	31681(25550)	157(108)		558(444)	

* U.S. FLAG CARRIERS ONLY
** INCLUDES FOREIGN FLAG ACTIVITY

Table B-42

1987 PROJECTED TOTAL
L.H. "USEABLE" CAPACITY (TONS)

	DOM1	DOM2	INT1 **	INT2 **
ATL	221107.	272094.	2817.	2686.
BOS	86301.	105350.	7018.	24902.
CHI	280917.	453432.	20289.	68913.
CLE	46760.	97804.	318.	712.
DAL/FTW	108423.	158293.	7336.	2506.
DEN	108945.	97031.	6641.	365.
DTW	77407.	112847.	5051.	8839.
HNL	93971.	39099.	44373.	39528.
IAH	42711.	75337.	9953.	11156.
KAN	44857.	60427.	50.	558.
LAS	10983.	32779.	518.	124.
LOS ANG	372256.	353101.	68102.	51806.
MIA/FTL	76183.	162325.	30343.	89415.
MSP	65041.	96179.	1673.	5905.
MSY	43023.	34790.	1313.	4666.
NYC/JFK	265226.	407669.	171457.	253092.
PHL	63764.	94468.	6061.	13914.
PIT	78991.	73396.	3298.	836.
STL	75475.	90130.	524.	221.
SFO/OAK	145561.	321203.	42186.	40032.
SJU	45045.	16393.	15700.	29358.
SEA/TAC	84501.	79319.	6506.	15060.
WAS/BLT	166896.	143938.	14934.	12864.
TPA	40601.	44718.	277.	823.
PHX	40812.	28378.	409.	839.

** INCLUDES FOREIGN FLAG ACTIVITY

Table B-43

1987
PROJECTED NO OF FRTR FLIGHTS (ACTUAL NO OF FLIGHTS APR 74 - MAR 75)
(SYS FRTR L.F.= .520) (SYS FRTR L.F.= .650)
(SYS TONS/DEPT= 45.0) (SYS TONS/DEPT= 54.0)

	DOM1	DOM2	INT1		INT2	
			**	*	**	*
ATL	0(1871)	0(216)	9(0)		0(0)	
BOS	1199(1756)	0(103)	1014(273)		157(1)	
CHI	9972(11334)	0(987)	4292(882)		0(42)	
CLE	1085(1188)	0(135)	249(0)		40(0)	
DAL/FTW	0(2222)	0(261)	0(0)		0(0)	
DEN	0(434)	0(33)	0(0)		0(0)	
DTW	2964(2975)	0(128)	1415(184)		78(3)	
HNL	0(1911)	0(405)	0(444)		0(40)	
IAH	652(775)	0(86)	443(0)		0(0)	
KAN	0(359)	0(183)	587(23)		8(0)	
LAS	0(0)	0(2)	0(0)		0(0)	
LOS ANG	5341(8349)	0(133)	2185(213)		0(15)	
MIA/FTL	286(693)	0(261)	5278(975)		0(53)	
MSP	36(532)	0(164)	0(1)		0(0)	
MSY	0(140)	0(0)	82(0)		87(0)	
NYC/EWR	9484(9515)	0(1654)	13650(2350)		0(260)	
PHL	1546(2357)	0(97)	389(148)		0(0)	
PIT	0(2)	0(2)	0(0)		0(0)	
STL	0(700)	0(3)	0(4)		0(0)	
SFO/OAK	4211(4752)	0(1745)	1088(933)		0(28)	
SJU	849(955)	0(0)	0(2)		0(0)	
SEA/TAC	1554(1305)	0(520)	217(315)		0(2)	
WAS/BLT	0(487)	0(77)	0(104)		0(0)	
TPA	0(0)	0(0)	33(0)		0(0)	
PHX	0(0)	0(0)	0(0)		0(0)	

* U.S. FLAG CARRIERS ONLY
** INCLUDES FOREIGN FLAG ACTIVITY

APPENDIX C

OUTBOUND VERSUS INBOUND CARGO ACTIVITY

Airport activity is usually measured in terms of number of aircraft departures (or operations which include arrivals) and enplanements of passengers and cargo tons. This paper has focused on projection of outbound traffic only. Airways and airport facility planners need estimates of total activity. In the case of air traffic, aircraft operations may be assumed to be double the projected number of departures since in the course of a year aircraft arrivals and departures balance. Hub passenger enplanement and deplanement activity should be essentially equal as well, at least to the level of measurement precision suggested by this forecasting procedure. Cargo activity, on the other hand, tends toward substantial imbalances and a simple doubling of the projected values for enplanements may not be an adequate estimate of total work load and facilities requirements at a hub.

In domestic service, the airline service segment data provides deplanements as well as enplanements at each airport. To provide a ready estimating device, the ratio of enplaned to deplaned cargo tons has been developed and listed on Table C-1 for each of the 25 large hubs. These ratios may be applied to the projected enplanements to estimate the deplanement tons.

In U.S. international service, the ratio of export to import tons was derived from the U.S. Department of Commerce data and listed in Table C-2. This is the only source which includes foreign flag activity.

A scan of the ratios on these two tables indicates that there is a substantial imbalance of cargo flows at some hubs. The imbalances are greater in the international flows than in the domestic flows.

Table C-1. Air Hub Cargo Enplaned/Deplaned Ratio - Domestic.

Hub	Mail	Freight and Express	Total Cargo
ATL	1.006	0.989	0.994
BOS	0.878	1.098	1.059
CHI	1.148	1.146	1.146
CLE	1.236	1.275	1.268
DAL	0.867	0.807	0.825
DEN	1.236	0.969	0.944
DTW	1.025	1.122	1.103
HNL	1.154	0.862	0.937
IAH	1.046	1.037	1.038
KAN	1.286	0.784	0.936
LAS	0.709	0.435	0.491
LOS ANG	1.037	1.112	1.280
MIA/FTL	0.843	0.958	0.889
MSP	0.996	1.099	1.068
MSY	0.644	0.748	0.719
NYC/NWK	1.419	0.940	1.022
PHL	1.306	1.132	1.174
PHX	0.670	0.734	0.714
PIT	0.936	0.901	0.913
STL	1.099	0.904	0.968
SFO/OAK	1.011	1.231	1.185
SJU	0.461	0.534	0.528
SEA/TAC	0.742	1.055	0.983
WAS/BAL	1.778	0.819	1.140
TPA	0.658	1.104	0.920

Source: CAB Airline Service Segment Data 12 Months Ending March 31, 1975.

Table C-2. Air Hub Cargo Enplaned/Deplaned Ratio - International.

Hub	Export Tons/Import Tons
ATL	2.046
BOS	1.176
CHI	2.573
CLE	3.798
DAL	1.731*
DEN	6.609*
DTW	1.144
HNL	3.971*
IAH	1.779*
KAN	3.472*
LAS	22.1 *
LOS ANG	1.339
MIA/FTL	2.113
MSP	1.554
MSY	2.2 *
NYC/NWK	1.354
PHL	2.140*
PHX	1.078
PIT	2.996*
STL	0.925*
SFO/OAK	0.986
SJU	0.465
SEA/TAC	0.538
WAS/BLT	0.663
TPA	1.388*

Source: U.S. Department of Commerce; U.S. General Imports, Exports 1974.

* Data available from first quarter 1975 only.

Report No. SS-211-U1-5

U. S. DEPARTMENT OF TRANSPORTATION
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FORECASTING MODELS AND FORECASTS OF U. S. DOMESTIC AND U. S. INTERNATIONAL AIR FREIGHT DEMAND

BY

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SEPTEMBER 1976

SPONSOR:

U.S. DEPARTMENT OF TRANSPORATION
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OFFICE OF AVIATION POLICY
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TECHNICAL SUMMARY

This paper documents an econometric model approach to long-term, national air freight demand forecasting. This approach provides forecasts founded on the premise that no dramatic technological or socio/political changes will occur in the forecast time frame. The econometric model approach assumes that shipper/receiver mode choice determinants are economic, remain essentially unchanged in the aggregate, and are adequately reflected by the selected equation variables. The authors believe that this model is at the current state-of-the-art of econometric forecasting; and given the available data, the current limits of this approach have been reached. Significant improvements in the accuracy or precision of the forecasts produced by these models require forecasts of individual commodity flows, mode split models, and more precise modeling of the price and service differential between the surface and air options available to the various groups of transportation users.

This paper also provides a basic forecast of U.S. domestic and U.S. international air freight demand at U.S. airports, for the time frame 1975 to 1990 which results from exercising the models with a specific set of input variable projections.

This forecast effort is part of a larger TSC project for the Federal Aviation Administration's Office of Aviation Policy, Aviation Forecast Branch, AVP-120.

TABLE OF CONTENTS

I INTRODUCTION

The purpose of this paper is to document an econometric model approach to long-term, macro air freight demand forecasting taken by the Transportation Systems Center for the Federal Aviation Administration. This paper also provides a basic forecast of U. S. domestic and U. S. international air freight demand[1] for the time frame 1975 to 1990 which result from exercising the models using a specific set of projections of the variable inputs. The basic forecast may be updated when improved projections of these model input variables become available. The models may also be used to develop a series of future demand scenarios based upon alternative forecasts of the input variables.

These macro forecasting models and the resultant forecasts constitute the first of a two part TSC effort. The second part[2] translates the national aggregate forecasts into projections of air cargo activity (cargo enplanements and aircraft operations) at individual U. S. air hubs. This package of models and computer programs and the forecasts not only support the FAA budget requests and policy and plan development, but also provide information required by local and regional planners of hub airport facilities.

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[1] Includes express but excludes mail which has been treated by the sponsor under a separate project.

[2] "Projections of Cargo Activity at U.S. Air Hubs" TSC Staff Study paper by D. Maio and N. Meltzer, Sept. 1976, SS-211-U1-4.

The econometric (or statistical) model approach has been taken to provide a base forecast founded on the premise that no dramatic technological or socio/political changes will occur in the forecast time frame. This approach assumes that shipper/consignee mode choice determinants are economic, will remain essentially unchanged in the aggregate, and are adequately reflected by the equation variables. It is felt that these models are at the current state-of-the-art of econometrics. Given the available data, the limits of this approach to air cargo forecasting have been reached. Significant improvements in the accuracy or precision of the forecasts require individual forecasts of specific commodity flows, credible mode split models, and more precise modeling of the price and service differentials between the surface and air options available to the various groups of transportation users. Research into these areas is currently underway at TSC under other OST projects. The results of these other projects should provide the FAA with the basis for a more sophisticated air freight forecasting approach.

The statistical forecasting methodology documented by this paper is composed of three steps (1) a search for the most significant factors affecting the demand for and the supply of air freight transportation services, (2) construction of regression equations for air freight traffic using variables for which consistent time series data are available, and (3) derivation of forecasts from the estimated regression models under alternative projections of future values for the exogenous variables.

Two explanatory variables form the basis for these models--GNP (an aggregate measure of economic activity) and Average Revenue Yield[3] (a surrogate for air service prices). Some twenty-five equations model the traffic demand for U. S. domestic air freight services and U. S. air export and air import services by U. S. flag carrier and foreign flag carriers between the U. S. and six world regions.[4] Two forms of regression equations have been developed for domestic services (i.e., a linear-functional form and a log-linear functional form). The log-linear form produced results which appear to be most consistent with current expectations of air cargo industry analysts and has been used to develop the base forecast. A linear-functional form proved most reasonable for the group of international models. The domestic models are discussed in detail in Section II and the international models are covered in Section III of this paper.

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[3]Average revenue yield ($/ton-mile) is the ratio of total annual revenue for a specific group of services to the ton-miles of traffic which produced that revenue.

[4]Including all scheduled and nonscheduled certificated carrier services.

The U. S. domestic model output units are revenue ton-miles (aggregated over all O-D pair flows). The U. S. international model output units are tons (by direction) for flows between the United States and specific world regions. Conversions of domestic traffic from ton-miles to tons and international traffic from tons to ton-miles is via application of projected average hauls. The specifics of these conversions are discussed in Section IV of this paper.

All time series data used in the development of the models and the projected input data for domestic and international services are reported in the Appendix.

II DOMESTIC AIR FREIGHT FORECAST

2.1 Historical Movements

In this study, the domestic air cargo or air freight traffic includes air express but not mail. The definitions of air freight and air express operations are discussed in detail in the Appendix of the CAB Handbook of Airline Statistics 1974 edition. The CAB time series data of domestic air freight and express for all scheduled and nonscheduled certificated carriers from 1950 to 1974 are used in this study. Table 2.1 presents the historical growth rates of air freight traffic. Over the entire sample period, the overall average annual growth rate of domestic air traffic for the twenty-four year period was 11.28 per cent.

TABLE 2.1 Historical Growth Rates of Domestic Air Freight Traffic 1950-74

Year	Growth Rates (%/year)
1950 - 55	8.4
1955 - 60	11.39
1960 - 65	19.14
1965 - 70	7.94
1970 - 74	6.34
1950 - 1974	11.28

The five-year interval historical growth rate had experienced an upward swing from 1950 to 1965, and then slipped downward gradually after 1965.

The average annual growth rate from 1961 to 1965 was the highest among the subperiods of this total time frame. Many factors caused this apparently abnormal growth rate in this five-year period. The swift conversion of the civil air fleet to jet aircraft with higher annual productivity and lower average operating costs, the great increase of volume and lift capacity in the heavy trunk routes and the availability of air cargo lift capability at more airports, increased the overall attractiveness of air freight services vis-a-vis surface modes for a broad spectrum of markets. The combination of the proliferation of available service, greatly increased capacity, significant reduction of the price differential between air and surface modes and a very high GNP growth rate is not expected to recur during the forecast time frame. It should not be surprising to find the log-linear form of the domestic model producing an overall average annual growth rate over the fifteen year forecast period of approximately 7 percent assuming the industry can maintain relatively constant price levels in real dollars over this period. Only if the real price of air freight services were to decline steadily at approximately 2 percent per year will the average annual growth rate approximate 11 percent.

2.2 The Model

In general, the demand for air freight is a function of general economic activities, air freight rates, the quality of air freight services and the price and quality of freight services provided by the competing modes. The quality of freight service includes (1) scheduled frequency, (2) the speed of the mode, (3) capacity offered, (4) the reliability of delivery time and (5) the probability of loss and damage. Unfortunately, there is no comprehensive and consistent set of data available on these measures of quality of freight service for this sample period. Thus, the initial statistical model for the demand for domestic air freight traffic is postulated as follows:

$$Y_t = \beta_o + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 Y_{t-1} + U_t \qquad (2.2.1)$$

where

$$o < \beta_4 < 1$$

Y_t = Total (freight plus express) domestic revenue ton-miles (all services--scheduled plus non-scheduled)

X_{1t} = Gross National Product measured in 1958 consant dollars

X_{2t} = Denotes freight rate. It is approximated by the yield per revenue ton-miles (scheduled air freight plus air express) deflated by implicit GNP price deflator (1958 = 100)

X_{3t} = It denotes a dummy variable to reflect the effect of a change in the reporting of the data, which included Alaska and Hawaii as domestic operation.

X_{3t} is specified as

$$X_{3t} = \begin{cases} 0 & t < 1969 \\ 1 & t \geq 1969. \end{cases}$$

The final model used in this study will be reported in the Section 2.4, Empirical Results, which is a modification of the model (2.2.1) based on the empirical information obtained from the sample data of the period of study.

2.3 The Data

Annual time series data covering the sample period from 1950 to 1974 are used in this study. The various measures of the variables and the sources of the data are discussed below:

Y_t = is measured by the millions of revenue ton-miles. The data of all services for air freight and air express are available from the various issues of the Handbook of Airline Statistics published by CAB.

Revenue ton-miles where chosen for the data unit of traffic volume because this was the only consistent time series data provided by the CAB for the sample period. Enplaned tons would have been preferable if available.

X_{1t} = it denotes real GNP in 1958 dollars

X_{2t}=represents real yield per revenue ton-miles.

The current yield per revenue ton-mile is obtained from the ratio of the sum of the total revenue of scheduled air freight and air express to the sum of their corresponding scheduled revenue ton-miles. The real yield per ton-mile

is defined as the current yield per ton-mile deflated by GNP price deflator (1958 = 100).

2.4 The Empirical Results

The model (2.2.1) with annual data from 1950 to 1974 was first estimated by instrumental variable estimator. The results were disappointing mainly because of the high intercorrelation among the variable X_{1t} and X_{2t}. To overcome this problem the model (2.2.1) was modified as follows:

$$Y_{1t} = \alpha_o + \alpha_1 \nabla X_{1t} + \alpha_2 X_{1t-1} + \alpha_3 X_{2t} + \alpha_4 X_{3t} + \alpha_5 Y_{1t-1} + U_t \qquad (2.3.1)$$

where

$$\nabla_{1t} = X_{1t} - X_{1t-1} \qquad 0 < \alpha_5 < 1$$

X_{1t-1} = real GNP lagged one period.

The model (2.3.1) can also be written as

$$Y_{1t} = \alpha_0 + \alpha_1 X_{1t} + (\alpha_1 + \alpha_2) X_{1t-1} + \alpha_3 X_{2t} + \alpha_4 X_{3t} + \alpha_5 Y_{1t-1} + U_t \qquad (2.3.1a)$$

It is known that the Durbin-Watson statistic has lower power in the case of model (2.3.1). Therefore, instrumental variable estimator is used to obtain the consistent estimate of the estimated residuals. The test of independence of U_t, based on $\hat{U}_t$, is carried out and the results indicated that we fail to reject the null hypothesis. Thus, the model (2.3.1) is estimated by ordinary least squares (OLS) and the resulting equation is

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FORECASTING MODELS FOR AIR FREIGHT DEMAND AND PROJECTION OF CAR--ETC(U)
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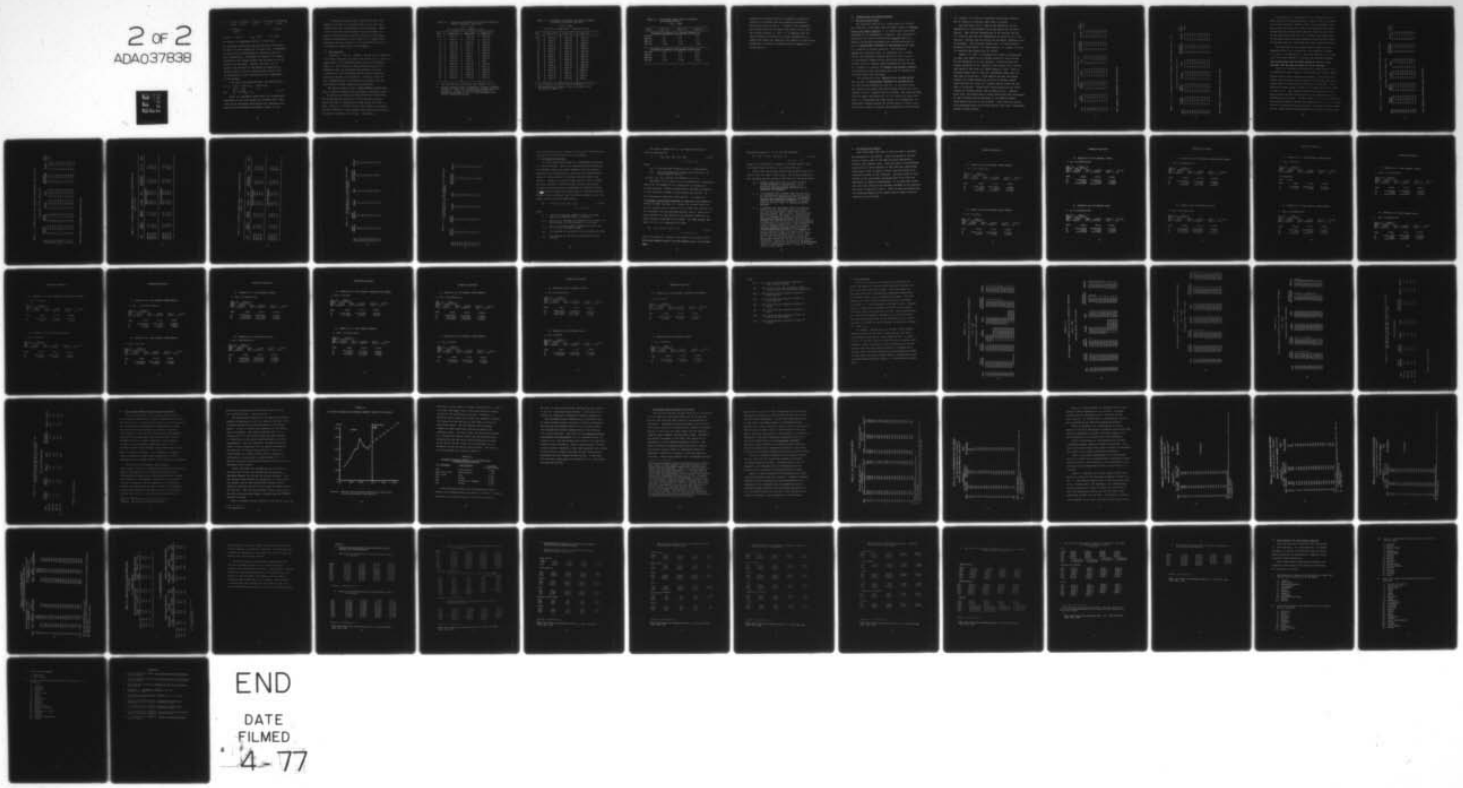

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$$Y_t = \underset{(0.83)}{776.33} + \underset{(4.7)}{4.85}\nabla X_{1t} + \underset{(1.9)}{1.79}X_{1t-1} - \underset{(-2.1)}{54.22}X_{2t} + \underset{(2.67)}{187.09}\, X_{3T}$$

$$+ \underset{(3.33)}{0.44}Y_{t-1} \qquad (2.3.2)$$

$F(5/19) = 631.59 \qquad \hat{\sigma}_{ut} = 88.77 \qquad R^2 = 0.99$

The numbers in parenthesis are the t statistics.

All estimated coefficients are statistically significant at least 10% level except the intercept term. Furthermore, the signs of the coefficients are consistent with our prior expectations. The demand for domestic air freight increases as the economy expands and decreases as the air freight rate increases. Overall, the model (2.3.2) explains the variation of the demand for domestic air freight traffic very well since the high values of R^2; the signficance of the F statistic and the independence of the residual.

A log term of the modified model estimates by GLS is

$$\ln Y_t = \underset{(0.22)}{0.91} + \underset{(4.4)}{1.84}\ln X_{1t} - \underset{(-3.3)}{1.89}\ln X_{2t}$$

and $$\hat{U}_t = 0.873\hat{U}_{t-1} + e_t \qquad (2.3.3)$$

Again, all regression coefficients are statistically significant at 5% level except the intercept term. The signs of the regression coefficients are consistent with those of the corresponding variables in model (2.3.2).

It should be mentioned that linear functional form (model 2.3.2) and log functional form (2.3.3) will have somewhat different implications for the forecasts. Model (2.3.2) will favor the hypothesis that air freight will reach a relatively mature market situation in the future, while the log-functional form (model 2.3.3) supports the hypothesis that the domestic air freight market is still in a substantial growth period of development.

2.5 The Forecasts

Tables 2.2 and 2.3 present the two sets of domestic air freight forecasts calculated from models (2.3.2) and 2.3.3), respectively. The predicted growth rates are reported in Table 2.4. The validity of these forecasts rest on the assumption that the estimated relationships are likely to continue in the forecasting period and the forecasted exogenous variables are realistic. Certainly, these are bold assumptions and the forecasts will deviate from the real values if these assumptions are erroneous.

The future values of GNP in 1958 constant dollars from 1975 to 1985 are obtained from the annual forecasts of GNP in '58 dollars from Wharton Economic Forecasting Associates. The average annual growth rate of GNP over this ten-year period was used to extrapolate the GNP values from 1986 to 1990. Future air freight revenue yield trends are projected by three alternative annual growth rates which should bracket the range of probable real values. Under Case 1,

TABLE 2.2 Forecasts of Domestic Air Freight Traffic in Revenue Ton-Miles (Millions)

1975 - 1990

(I)[a] Linear Form - Equation (2.3.2)

Year	Case (1)[b]	Case (2)[b]	Case (3)[b]
1975	2725.17	2740.68	2795.65
76	2934.19	2973.94	3031.14
77	3021.45	3089.17	3163.38
78	3043.26	3140.95	3238.36
79	3144.78	3273.7	3396.69
80	3272.13	3433.15	3582.47
81	3474.21	3668.1	3843.77
82	3400.86	3628.3	3830.04
83	3488.81	3650.5	3877.93
84	3547.69	3844.42	4097.
85	3694.96	4027.36	4304.64
86	3793.43	4162.21	4463.71
87	3899.36	4305.24	4630.48
88	4011.18	4454.93	4803.43
89	4128.47	4610.82	4982.12
90	4251.05	4772.79	5166.43

a The forecasts are calculated from equation (2.3.2).

b Freight revenue yield is assumed to increase 2 percent annually in Case 1 and to decrease 2 percent annually in Case 3. In Case 2, freight revenue yield is assumed to be equal to that of 1974 throughout the entire forecasting period.

TABLE 2.3 Forecasts of Domestic Air Freight Traffic in Revenue Ton-miles (million)

1975 - 1990

(II)[c] Log - Linear Form - Equation (2.3.3)

Year	Case (1)[b]	Case (2)[b]	Case (3)[b]
1975	2875.55	2980.96	3103.23
76	3053.37	3261.69	3533.34
77	3133.8	3512.21	3940.25
78	3146.35	3657.37	4259.9
79	3251.92	3924.54	4750.47
80	3403.3	4264.16	5366.87
81	366.53	4772.38	6241.65
82	3588.9	4846.44	6587.97
83	3597.52	4964.16	7016.36
84	3694.5	5377.61	7895.12
85	3858.37	5836.58	8892.83
86	3974.28	6239.78	9887.24
87	4092.04	6667.5	10981.9
88	4213.25	7129.52	12197.1
89	4338.14	7623.57	13548.1
90	4467.12	8151.84	15063.

c The forecasts are calculated from equation (2.3.3).

b The definitions of Case 1, Case 2 and Case 3 are discussed in Table 2.2.

TABLE 2.4 Forecasted Growth Rates of Domestic Air Freight Traffic

1975 - 1990

Year	Case (1)	Case (2)	Case (3)
Forecasts of Domestic Air Freight Traffic (I)			
1975-80	3.7	4.6	5.1
1980-85	2.5	3.2	3.7
1985-90	2.8	3.5	3.7
1975-90	3.00	3.77	4.18
Forecasts of Domestic Air Freight Traffic (II)			
1975-80	3.4	7.4	11.6
1980-85	2.5	6.5	10.6
1985-90	3.0	6.9	11.1
1975-90	3.00	6.94	11.10

aggregate air freight prices are assumed to increase an average of 2% annually, and are assumed to decrease by about 2% per year in Case 3. In Case 2, the forecasted air freight yield is the same as the value of real yield per revenue ton-mile in 1974. It is expected that the three alternative freight price trend assumptions will reflect the likely net impacts of any advance in cost-saving technology or increase in operating cost in domestic air freight service.

III INTERNATIONAL AIR FREIGHT FORECAST

3.1 The Past Growth Trend

The historical data of U.S. international air freight from 1965-1974 is available from the annual issues of Airborne Exports and General Imports, U. S. Foreign Trade Statistics published by U.S. Department of Commerce. The statistics on exports by air from the United States include exports of domestic and foreign merchandise and include government as well as nongovernment shipments of merchandise by air from U.S. airports to foreign countries. The statistics exclude the following items: (1) shipments to U.S. Armed Forces and diplomatic missions abroad for their own use; (2) merchandise shipped through the United States from one foreign country to another when documented as such through U.S. Customs; (3) exports of household and personal effects; (4) shipments by mail and parcel post; and (5) shipments of airplanes under their own power.

The statistics on U.S. imports by air include government as well as nongovernment shipments of merchandise by air from foreign countries to the U.S. It is worth noting that imports into Puerto Rico from foreign countries are considered to be U.S. imports and are included. The items excluded from the import statistics are (1) U.S. trade with Puerto Rico and U. S. possessions and trade between U.S. possessions; (2) merchandise shipped through the United States in transit from one foreign country to another when documented as such through

U.S. Customs; (3) imports of household and personal effects; and (4) imports of airplane under their own power.

The statistics of U.S. exports and imports by air are aggregation of flows between the United States and six world regions. They are also aggregations of all carriers serving U.S. airports and also the aggregations of subset of U.S. flag carriers. Foreign flag activities are available, therefore, only as residuals. The six world regions are: (1) North America excluding United States, (2) South America, (3) Europe, (4) Asia, (5) Australia and Oceania and (6) Africa.

Tables 3.1.1 and 3.1.2 presents the trends in percentages of export and import of air freight traffic by world regions for the aggregate of all air carriers. Europe has been the largest recipient of U.S. exports of air freight with a 45 percent share of the total U.S. export market in 1974. This is slightly higher than in 1965 but considerably lower than the 1967 peak of 52 percent. North America has been the second largest air freight market but its 1974 20 percent market share has been the result of a gradual decline since the 1967 peak of 32 percent. Before 1969, South America was the third largest air freight market, and followed by Asia. However, since 1969, the growth rate of Asian traffic has been outstripped by that of South America resulting in the ranking between South America and Asia to be reversed. Since 1965 Asia gained nine percentage points while South America lost over 3 percentage points in market shares.

TABLE 3.1.1 - U.S. EXPORTS BY ALL AIR CARRIERS BY WORLD REGION (1965 to 1974)

Year	Percentage of Total Export Tons						U.S. Total %
	North America	South America	Europe	Asia	Australia and Oceania	Africa	
1965	(2) 30.15	(3) 16.90	(1) 43.11	(4) 6.90	(6) 1.19	(5) 1.75	100%
1966	(2) 29.17	(3) 15.35	(1) 44.51	(4) 7.99	(6) 1.25	(5) 1.73	
1967	(2) 28.01	(3) 13.10	(1) 45.92	(4) 9.49	(6) 1.57	(5) 1.91	
1968	(2) 28.11	(3) 11.92	(1) 46.37	(4) 9.37	(6) 1.99	(5) 2.24	
1969	(2) 24.86	(3) 11.71	(1) 49.06	(4) 10.25	(6) 1.68	(5) 2.44	
1970	(2) 25.19	(4) 10.72	(1) 48.12	(3) 12.06	(6) 1.79	(5) 2.12	
1971	(2) 25.23	(4) 11.31	(1) 45.13	(3) 13.85	(6) 2.04	(5) 2.44	
1972	(2) 23.60	(4) 11.86	(1) 46.25	(3) 14.58	(6) 1.79	(5) 1.92	
1973	(2) 20.91	(4) 10.99	(1) 47.35	(3) 16.55	(5) 2.21	(6) 1.99	
1974	(2) 20.37	(4) 13.37	(1) 45.41	(3) 15.92	(5) 2.53	(6) 2.40	

Note: Numbers in parentheses denote rank order

TABLE 3.1.2 - U.S. IMPORTS BY ALL AIR CARRIERS BY WORLD REGIONS (1964 to 1974)

Percentage of Total Import Tons

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	U.S. Total %
1964	(2) 24.13	(3) 11.20	(1) 53.22	(4) 10.73	(6) 0.21	(5) 0.51	100%
1965	(3) 17.22	(4) 10.31	(1) 57.99	(3) 13.89	(6) 0.19	(5) 0.40	
1966	(3) 16.91	(4) 6.70	(1) 58.51	(2) 17.05	(6) 0.31	(5) 0.52	
1967	(3) 16.34	(4) 6.32	(1) 58.55	(2) 17.88	(6) 0.44	(5) 0.47	
1968	(3) 16.40	(4) 4.95	(1) 59.03	(2) 18.64	(5) 0.54	(6) 0.43	
1969	(3) 14.72	(4) 4.80	(1) 61.43	(2) 18.14	(5) 0.53	(6) 0.37	
1970	(3) 13.75	(4) 6.99	(1) 57.11	(2) 21.19	(5) 0.54	(6) 0.42	
1971	(3) 11.34	(4) 8.29	(1) 53.40	(2) 26.03	(5) 0.59	(6) 0.35	
1972	(3) 10.93	(4) 8.84	(1) 52.45	(2) 26.57	(5) 0.67	(6) 0.54	
1973	(3) 11.68	(4) 10.65	(1) 51.30	(2) 25.35	(5) 0.63	(6) 0.38	
1974	(3) 13.48	(4) 12.14	(1) 48.31	(2) 24.78	(5) 0.72	(6) 0.57	

Note: Numbers in parentheses denote rank order

In this period, the patterns of U.S. imports from the world regions are roughly similar to those of the U.S. exports to the world regions. However, there is one exception, the Asian region has moved up in rank to second place and outdistanced the third ranking North American region by more than eleven percentage points in 1974. Further, the market share of the Asian region has been steadily increasing while those of the North America and Europe have been trending downward.

The percentage of air exports and air imports by the aggregate of all U.S. flag carriers are reported in Tables 3.1.3 and 3.1.4 respectively. From these Tables, it is clear that the traffic patterns, including the imbalances between **the United States and the world regions of the U.S. flag carriers, are the same as those of all air carriers.**

Table 3.1.5 presents the historical growth rates of U.S. air exports by world regions. We find that the average annual growth rates of Asia, Australia and Oceania, and Africa were larger than 20 percent and the growth rates of the other three regions were in the range of 10 percent to 20 percent. The historical growth rates of import air freight traffic are shown in Table 3.1.6. The relative growth rates between the U.S. Flag Carriers and the foreign flag carriers apparently varies depending on the region. Finally, Table 3.1.7 and 3.1.8 describe the relative change in market share behaviors of U.S. air carriers to all air carriers during this period. The market share enjoyed by U.S. flag carriers varies substantially among the markets and

TABLE 3.1.3 - EXPORTS BY U.S. CARRIERS BY WORLD REGIONS (1965 to 1974)

Percentage of Total Export Tons

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	U.S. Total %
1965	(2) 35.59	(3) 12.11	(1) 40.21	(4) 9.53	(6) 0.71	(5) 1.85	100%
1966	(2) 37.57	(3) 11.31	(1) 38.71	(4) 9.96	(6) 0.79	(5) 1.66	
1967	(2) 36.20	(4) 10.33	(1) 39.94	(3) 11.26	(6) 1.07	(5) 1.20	
1968	(2) 35.62	(3) 11.05	(1) 40.30	(4) 10.04	(6) 1.45	(5) 1.54	
1969	(2) 31.73	(4) 10.25	(1) 44.80	(3) 10.81	(6) 0.91	(5) 1.50	
1970	(2) 28.58	(4) 10.26	(1) 45.29	(3) 13.78	(6) 0.91	(5) 1.18	
1971	(2) 28.36	(4) 10.24	(1) 41.41	(3) 17.01	(5) 1.53	(6) 1.45	
1972	(2) 27.04	(4) 10.61	(1) 41.64	(3) 18.44	(5) 1.29	(6) 0.98	
1973	(2) 24.22	(4) 10.13	(1) 43.65	(3) 18.86	(5) 1.73	(6) 1.41	
1974	(2) 22.22	(4) 12.27	(1) 44.23	(3) 17.31	(5) 2.16	(6) 1.81	

Note: Numbers in parentheses denote rank order

TABLE 3.1.4 - IMPORTS BY U.S. FLAG CARRIERS BY WORLD REGION (1964 to 1974)

Percentage of Total Import Tons

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	U.S. Total %
1964	(2) 22.70	(4) 6.63	(1) 54.30	(3) 15.84	(6) 0.07	(5) 0.46	100%
1965	(3) 16.44	(4) 6.72	(1) 58.11	(2) 18.38	(6) 0.07	(5) 0.28	
1966	(3) 16.18	(4) 5.06	(1) 54.91	(2) 23.17	(6) 0.31	(5) 0.37	
1967	(3) 15.61	(4) 5.75	(1) 52.23	(2) 25.96	(6) 0.20	(5) 0.25	
1968	(3) 17.60	(4) 4.58	(1) 51.24	(2) 25.94	(5) 0.38	(6) 0.26	
1969	(3) 14.36	(4) 4.15	(1) 56.89	(2) 24.11	(5) 0.28	(6) 0.21	
1970	(3) 13.53	(4) 6.40	(1) 51.51	(2) 27.96	(5) 0.32	(6) 0.24	
1971	(3) 10.36	(4) 8.11	(1) 48.11	(2) 32.75	(5) 0.48	(6) 0.19	
1972	(3) 9.72	(4) 8.78	(1) 46.65	(2) 33.49	(5) 0.89	(6) 0.46	
1973	(3) 11.27	(4) 9.99	(1) 47.71	(2) 30.18	(5) 0.68	(6) 0.17	
1974	(3) 12.02	(4) 10.36	(1) 49.77	(2) 26.75	(5) 0.79	(6) 0.32	

Note: Numbers in parentheses denote rank order

TABLE 3.1.5 - HISTORICAL GROWTH RATES OF U.S. EXPORT TONS BY AIR
(1965 to 1974)

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	Total
			All Air Carriers				
1965-68	13.0	3.0	18.5	28.1	37.5	25.4	
1968-71	7.3	9.3	10.2	26.7	12.1	14.6	
1971-74	12.4	27.6	21.0	26.5	29.7	20.0	
1965-74	10.9	12.8	16.5	27.1	26.0	19.9	
			U.S. Air Carriers				
1965-68	16.7	13.2	16.8	18.7	48.2	9.8	
1968-71	0.9	6.1	9.9	29.8	10.9	6.8	
1971-74	9.8	26.5	21.7	19.8	33.6	28.2	
1965-74	9.0	15.0	16.0	22.7	30.0	14.5	

TABLE 3.1.6 - HISTORICAL GROWTH RATES OF U.S. IMPORT TONS BY AIR
(1965 to 1974)

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	Total
			All Air Carriers				
1965-68	28.7	20.4	31.6	44.2	84.1	33.9	
1968-71	9.8	47.5	20.1	38.8	28.3	15.8	
1971-74	15.0	23.3	5.0	6.8	15.5	28.2	
1965-74	17.6	23.0	18.4	28.9	39.7	25.8	
			U.S. Air Carriers				
1965-68	30.5	12.2	22.3	43.1	119.5	25.1	
1968-71	3.6	49.6	21.0	33.6	33.5	10.3	
1971-74	10.2	13.8	6.1	-2.0	23.8	26.5	
1965-74	14.2	24.1	16.3	23.3	53.6	20.4	

TABLE 3.1.7 THE EXPORTS BY U.S. FLAG CARRIERS AS THE PERCENT OF THE EXPORTS BY ALL AIR CARRIERS

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa
1965	44	27	35	52	22	40
1966	48	27	32	46	24	35
1967	47	28	31	43	25	23
1968	49	36	34	41	28	27
1969	50	34	35	41	21	24
1970	41	35	34	41	18	20
1971	41	33	33	44	27	21
1972	39	31	31	43	25	17
1973	41	33	33	40	28	25
1974	38	32	34	38	30	26

TABLE 3.1.8 THE IMPORTS BY U.S. FLAG CARRIERS AS THE PERCENTAGE OF THE IMPORTS BY ALL AIR CARRIERS

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa
1964	43	27	47	68	16	42
1965	48	32	50	66	19	35
1966	46	37	45	66	49	35
1967	39	38	37	66	19	22
1968	50	43	40	64	33	28
1969	44	39	42	60	23	26
1970	46	43	42	62	27	27
1971	42	45	41	57	37	24
1972	40	44	40	56	60	38
1973	43	41	41	53	48	20
1974	37	35	42	44	46	23

varies with direction of flow but it has with a few exceptions remained well below one-half the total tonnage.

3.2 The Model and the Data

It is well known that demand for transportation services is a derived demand. Hence, the important factors affecting the aggregate import and export demand will be the natural candidates for consideration in selecting the determinants of demand for international air freight services (export and import). Further, air freight rates, quality of air freight services, quality of surface freight services and surface freight rates should also be considered as important factors influencing the demand for international air freight services. Based on these considerations, the general demand for U.S. air export services would be specified as

$$B_i = f(Y_i, P_{1i}, P_{2i}, X_{1i}, X_{2i}) \qquad (3.2.1)$$

$$i = 1.2,...6.$$

where

Y_i = real Gross National Product of the i th world region (in constant 1958 U.S. dollars)

P_{1i} = the real air freight rate from the U.S. to the i th world region (in 1958 constant U.S. dollars)

P_{2i} = the real average surface freight rates from the U.S. to the i th world region.

X_{1i} = the measures of the quality of air freight services

X_{2i} = the measures of the quality of surface freight services

The general demand for U.S. air import services can also be specified as:

$$I_i = f(Y_{us}, \bar{P}_{1i}, \bar{P}_{2i}, X_{1i}, X_{2i}) \qquad (3.2.2)$$

$$i = 1.2,\ldots,6$$

where

Y_{us} = Gross National Product of U.S. in 1958 dollars

$\bar{P}_{1i}$ = the real average air freight rate from the i th world region to the U.S.

and $\bar{P}_{2i}$, X_{1i}, X_{2i}, and X_{3i} are defined in (3.2.1).

The models (3.2.1) and 3.2.2) are considered as theoretical models for the demand for U.S. export and U.S. import air freight services. Based on these models, the data availability of the variables included in these models was studied. We have encountered three main difficulties: (1) there are no reliable quantitative measures on quality of air freight or surface freight services; (2) average air freight rates and surface freight rates by world regions (inflow and outflow) are not available from the published sources; and (3) there are no data available for the implicit price deflator (1958=100) by world regions as defined in this study. For this reason, the model of (3.2.1) is simplied as follows:

$$\ln I_i = \alpha_0 + \alpha_1 P_1 + \alpha_2 Y_i + U_i \qquad (3.2.3)$$

$$i = 1,2,\ldots,6,$$

where the subscript i refers to the export air freight traffic for United States to the i th world regions and U_i is an error term.

The modified model of (3.2.2) has the following

$$I_h = \beta_0 + \beta_1 P_{1i} + \beta_2 Y_{us} + U_h \qquad (3.2.4)$$

$$h = 1.2,\ldots,6$$

where I_h is the demand for import air freight traffic from h th world region to the U.S. U_h is an error term.

Annual time series data covering the sample period from 1965 to 1974 are used in this study. The various measures of the variables and the sources of the data are discussed below:

Y_{us} = denotes annual data for U.S. Gross National Product measured in 1958 dollars. It is available from the various issues of the Survey of Current Business published by the Department of Commerce.

P_i = it represents real revenue yield per ton-mile of International operations. The current yield per ton-mile is obtained from CAB, Air Carrier Traffic and Financial Statistics and the GNP implicit price deflator (1958=100) is obtained from the various issues of Survey of Current Business.

Y_i = it denotes the approximate real gross domestic product of the i th world region in terms of U.S. dollars (millions). The current Gross Domestic Product (GDP) of the i th world region is calculated in four steps: (1) the value of GDP of the member countries are obtained from Statistical Yearbook, published by the United Nations, (2) the annual GDP in local currencies is converted to U.S. dollars by the corresponding annual foreign exchange rate. The historical foreign exchange rates are reported in International Financial Statistics published by International Montary Fund, (3) the normal GDP in U.S. dollars of the i th world region is obtained by the summation of GDP in U.S. dollar of the countries in that region, (4) the real GDP of the i th world region is obtained by deflating norminal GDP by the U.S. price deflator (1958=100). Certainly, It should be mentioned that the estimated real GDP of the i th world region is only a rough approximation of the real income trend of that region.

3.3 The Empiricial Results

Time series data from 1965 to 1974 are used to estimate the parameters of the models. Since the length of the data series is short, most of the equations were estimated by ordinary least squares (OLS). When the value of Durbin-Watson statistics of a given equation is less than one, generalized least square (GLS) is used to correct the first-order auto-regressive process in the residuals. The main reason to take account of the first-order autocorrelation is to avoid the pheonomenon of spurious regressions. It is also worth noting that the final choice of the variable included in the equations was based on empirical results. Based on these considerations, the estimated demand for air import and air export services equations are as follows:

REGRESSION EQUATIONS

(1) EXPORTS BY ALL AIR CARRIERS (NORTH AMERICA)

1: ENA = C1+C2*RNA+C3*IPD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.97709 CRSQ = 0.97055 F(2/7) = 149.295
SER = 1.10E+04 SSR = 8.518E+08 DW(0) = 1.55

COEF	VALUE	ST ER	T-STAT
C1	96596.20000	98079.90000	0.98487
C2	2.43915	0.35072	6.95475
C3	-7431.65000	4141.38000	-1.79448

(2) EXPORTS BY ALL AIR CARRIERS (SOUTH AMERICA)

1: ESA = C1+C2*RSA

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.88821 CRSQ = 0.87423 F(1/8) = 63.560
SER = 1.59E+04 SSR = 2.024E+09 DW(0) = 1.47

COEF	VALUE	ST ER	T-STAT
C1	-62775.60000	21991.80000	-2.85450
C2	2.16737	0.27186	7.97242

REGRESSION EQUATIONS

(3) EXPORTS BY ALL AIR CARRIERS (EUROPE)

1: EE = C1+C2*REU+C3*IRD

NOB = 10 NOVAR = 3-
RANGE = 1965 TO 1974
RSQ = 0.96854 CRSQ = 0.95955 F(2/7) = 107.758
SER = 3.61E+04 SSR = 9.134E+09 DW(0) = 1.51

COEF	VALUE	ST ER	T-STAT
C1	4.77947E+05	2.35056E+05	2.03333
C2	0.80941	0.12399	6.52804
C3	-34596.90000	10625.20000	-3.25610

(4) EXPORTS BY ALL AIR CARRIERS (ASIA)

1: EA = C1+C2*RAS+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.99614 CRSQ = 0.99504 F(2/7) = 904.168
SER = 5.46E+03 SSR = 2.087E+08 DW(0) = 2.19

COEF	VALUE	ST ER	T-STAT
C1	-83375.10000	36708.90000	-2.27125
C2	0.78781	0.03323	23.70830
C3	-2127.82000	1747.45000	-1.21767

REGRESSION EQUATIONS

(5) EXPORTS BY ALL AIR CARRIERS (AUSTRALIA AND OCEANIA)

1: EAO = C1+C2*RAO+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.93763 CRSQ = 0.91982 F(2/7) = 52.621
SER = 3.10E+03 SSR = 6.720E+07 DW(0) = 1.48

COEF	VALUE	ST ER	T-STAT
C1	-18753.10000	21872.30000	-0.85739
C2	1.27751	0.22002	5.80631
C3	-434.32300	957.37100	-0.45366

(6) EXPORTS BY ALL AIR CARRIERS (AFRICA)

1: EAF = C1+C2*PAF+C2*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.8857 CRSQ = 0.85305 F(2/7) = 27.122
SER = 3.60E+03 SSR = 9.055E+07 DW(0) = 1.85

COEF	VALUE	ST ER	T-STAT
C1	-3.97182E+05	1.45528E+05	-2.72924
C2	40677.60000	12121.70000	3.35576
C3	-1521.71000	1084.25000	-1.40347

REGRESSION EQUATIONS

(1) EXPORTS BY U. S. FLAG CARRIERS (NORTH AMERICA)

1: FENA = C1+C2*RNA

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.72397 CRSQ = 0.68946 F(1/8) = 20.982
SER = 8.69E+03 SSR = 6.043E+08 DW(0) = 1.40

GLS PARAMETERS

RHO1 0.5226

COEF	VALUE	ST ER	T-STAT
C1	-4326.01000	21396.50000	-0.20218
C2	0.97283	0.21238	4.58059

(2) EXPORTS BY U.S. FLAG CARRIERS (SOUTH AMERICA)

1: FESA = C1+C2*RSA+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.86984 CRSQ = 0.83265 F(2/7) = 23.389
SER = 6.13E+03 SSR = 2.634E+08 DW(0) = 1.31

COEF	VALUE	ST ER	T-STAT
C1	4494.75000	40039.90000	0.11226
C2	0.62741	0.16510	3.80005
C3	-1213.25000	1796.69000	-0.67527

REGRESSION EQUATIONS

(3) EXPORTS BY U.S. FLAG CARRIERS (EUROPE)

1: FEEU = C1+C2*REU+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.92875 CRSQ = 0.90839 F(2/7) = 45.622
SER = 1.81E+04 SSR = 2.291E+09 DW(_-0 = 1.40

COEF	VALUE	ST ER	T-STAT
C1	1.65895E+05	1.17708E+05	1.40938
C2	0.26003	0.06209	4.18802
C3	-11617.30000	5320.74000	-2.18339

(4) EXPORTS BY U.S. FLAG CARRIERS (ASIA)

1: FEA = C1+C2*RAS+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.98519 CRSQ = 0.98096 F(2/7) = 232.813
SER = 4.08E+03 SSR = 1.166E+08 DW(0) = 1.23

COEF	VALUE	ST ER	T-STAT
C1	-11563.00000	27443.80000	-0.42133
C2	0.28651	0.02484	11.53310
C3	-1582.02000	1306.41000	-1.21097

REGRESSION EQUATIONS

(5) EXPORTS BY U.S. FLAG CARRIERS (AUSTRALIA AND OCEANIA)

1: FEAO = C1+C2*RAO

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.90709 CRSQ = 0.89547 F(1/8) = 78.101
SER = 1.09E+03 SSR = 9.464E+06 DW(0) = 1.76

COEF	VALUE	ST ER	T-STAT
C1	-9365.47000	1597.09000	-5.86408
C2	0.41083	0.04649	8.83749

(6) EXPORTS BY U.S. FLAG CARRIERS (AFRICA)

1: FEAF = C1+C2*RAF

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.76232 CRSQ = 0.73261 F(1/8) = 25.658
SER = 1.17E+03 SSR = 1.104E+07 DW(0) = 1.71

COEF	VALUE	ST ER	T-STAT
C1	-7184.09000	2352.92000	-3.05326
C2	0.22971	0.04535	5.06540

REGRESSION EQUATIONS

(1) IMPORTS BY U.S. FLAG CARRIERS (NORTH AMERICA)

1: FINA = C1+C2*GNP+C3*FINA(-1)

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.92423 CRSQ = 0.90258 F(2/7) = 42.693
SER = 4.02E+03 SSR = 1.132E+08 DW(0) = 1.70

COEF	VALUE	ST ER	T-STAT
C1	-50840.90000	23551.90000	-2.15868
C2	98.54420	40.20590	2.45098
C3	0.44249	0.22161	1.99669

(2) IMPORTS BY U.S. FLAG CARRIERS (SOUTH AMERICA)

1: FISA = C1+C2*GNP

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.88222 CRSQ = 0.8675 F(1/8) = 59.923
SER = 5.84E+03 SSR = 2.727E+08 DW(0) = 0.95

COEF	VALUE	ST ER	T-STAT
C1	-1.32820E+05	20014.70000	-6.63613
C2	211.18900	27.28180	7.74100

REGRESSION EQUATIONS

(3) IMPORTS BY U.S. FLAG CARRIERS (EUROPE)

1: FIEU = C1+C2*GNP+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.91629 CRSQ = 0.89237 F(2/7) = 38.309
SER = 2.08E+04 SSR = 3.022E+09 DW(0) = 1.48

COEF	VALUE	ST ER	T-STAT
C1	-1.27668E+05	3.80923E+05	-0.33515
C2	597.72300	281.36800	2.12435
C3	-10482.40000	11198.10000	-0.93609

(4) IMPORTS BY U.S. FLAG CARRIERS (ASIA)

1: FIA = C1+C2*GNP+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.86294 CRSQ = 0.82378 F(2/7) = 22.036
SER = 1.96E+04 SSR = 2.684E+09 DW(0) = 1.03

COEF	VALUE	ST ER	T-STAT
C1	-2.18673E+05	3.59038E+05	-0.60905
C2	503.62500	265.20300	1.89902
C3	-4354.64000	10554.70000	-0.41258

REGRESSION EQUATIONS

(5) IMPORTS BY U.S. FLAG CARRIERS (AUSTRALIA AND OCEANIA)

1: FIAO = C1+C2*GNP

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.85059 CRSQ = 0.83192 F(1/8) = 45.546
SER = 569.6670 SSR = 2.596E+06 DW(0) = 1.80

COEF	VALUE	ST ER	T-STAT
C1	-11614.70000	1952.91000	-5.94738
C2	17.96510	2.66199	6.74874

(6) IMPORTS BY U.S. FLAG CARRIERS (AFRICA)

1: FIAF = C1+C2*GNP+C3*DUF

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.90918 CRSQ = 0.88323 F(2/7) = 35.037
SER = 176.4220 SSR = 2.179E+05 DW(0) = 1.25

COEF	VALUE	ST ER	T-STAT
C1	-1062.05000	713.02700	-1.48949
C2	2.24173	0.99843	2.24526
C3	910.80500	168.91600	5.39206

REGRESSION EQUATIONS

(1) IMPORTS BY ALL AIR CARRIERS (NORTH AMERICA)

1: INA = C1+C2*GNP+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.91277 CRSQ = 0.88785 F(2/7) = 36.623
SER = 1.16E+04 SSR = 9.488E+08 DW(0) = 1.84

COEF	VALUE	ST ER	T-STAT
C1	-1.58718E+05	2.13447E+05	-0.74360
C2	395.25500	157.66300	2.50696
C3	-2952.48000	6274.77000	-0.47053

(2) IMPORTS BY ALL AIR CARRIERS (SOUTH AMERICA)

2: ISA = C1+C2*GNP

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.8417 CRSQ = 0.82191 F(1/8) = 42.538
SER = 1.72E+04 SSR = 2.363E+09 DW(0) = 0.99

COEF	VALUE	ST ER	T-STAT
C1	-3.29220E+05	58915.20000	-5.58803
C2	523.76700	80.30660	6.52209

REGRESSION EQUATIONS

(3) IMPORTS BY ALL AIR CARRIERS (EUROPE)

1: IE = C1+C2*GNP+C3*IRD

NOB = 10 NOVAR = 3
RANGE = 1965 TO 1974
RSQ = 0.93756 CRSQ = 0.91971 F(2/7) = 52.550
SER = 4.43E+04 SSR = 1.377E+10 DW(0) = 1.65

COEF	VALUE	ST ER	T-STAT
C1	-95052.40000	8.13025E+05	-0.11691
C2	1323.99000	600.54000	2.20467
C3	-33111.30000	23900.70000	-1.38537

(4) IMPORTS BY ALL AIR CARRIERS (ASIA)

1: IA = C1+C2*GNP

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.91275 CRSQ = 0.90185 F(1/8) = 83.693
SER = 2.95E+04 SSR = 6.941E+09 DW(0) = 1.36

COEF	VALUE	ST ER	T-STAT
C1	-7.77790E+05	1.00976E+05	-7.70272
C2	1259.18000	137.63900	9.14838

REGRESSION EQUATIONS

(5) IMPORTS BY ALL AIR CARRIERS (AUSTRALIA AND OCEANIA)

1: IAO = C1+C2*GNP

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.93947 CRSQ = 0.93191 F(1/8) = 124.169
SER = 657.4780 SSR = 3.458E+06 DW(0) = 2.16

COEF	VALUE	ST ER	T-STAT
C1	-21374.10000	2253.94000	-9.48298
C2	34.23530	3.07232	11.14310

(6) IMPORTS BY ALL AIR CARRIERS (AFRICA)

1: IAF = C1+C2*GNP

NOB = 10 NOVAR = 2
RANGE = 1965 TO 1974
RSQ = 0.81591 CRSQ = 0.7929 F(1/8) = 35.458
SER = 774.9510 SSR = 4.804E+06 DW(0) = 2.84

COEF	VALUE	ST ER	T-STAT
C1	-12969.30000	2656.66000	-4.88180
C2	21.56330	3.62126	5.95463

where

GNP = U.S. Gross National Product measured in 1958 constant dollars

IRD = Real average yield per ton-miles (cents, international and territorial operations)

RNA = Real Gross National Domestic Product of North America

RSA = Real Gross National Domestic Product of South America

REU = Real Gross National Domestic Product of Europe

RAS = Real Gross National Domestic Product of Asia

RAO = Real Gross National Domestic Product of Australia and Oceania

RAF = Real Gross National Domestic Product of Africa

3.4 The Forecasts

Table 3.4.1 through 3.4.4 present the forecasts of export and import air freight traffic by world regions and by air carriers from 1975 to 1990. These forecasts are generated from their corresponding regression models under the assumed future value of exogenous variables. The Forecasts of U.S. GNP in 1958 constant dollars are discussed in Section 2.5. The forecasts of real GDP of the i th world region is obtained by extrapolation based on its average of annual growth rate from 1965 to 1974. Real revenue yield per ton-mile is assumed to decrease at 2 percent annually. The predicted growth rates of the forecasts of U.S. international air freight by world regions are reported in Tables 3.4.5 and 3.4.6.

In summary, international air freight traffic should continue to grow in the next 15 years but at less rapid rates compared with those in the sample period. In terms of U.S. air freight traffic to and from the individual world regions, Europe and Asia are the two dominant air freight markets with the Asian market growing at a substantially greater rate. The North American and South American markets are the third and fourth largest markets, respectively, with the South American market growing at a substantially greater rate.

TABLE 3.4.1

THE FORECASTS OF EXPORTS BY ALL AIR CARRIERS BY CONTINENT

1975 - 1990

Shipping Weight (1000 pounds)

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa
1975	336491.	199931.	754908.	287310.	40437.1	34993.7
1976	363634.	218977.	825304.	324051.	45308.4	37417.7
1977	392534.	239404.	900199.	364031.	50521.3	39833.
1978	423321.	261312.	979964.	407543.	56100.7	42239.6
1979	456135.	284808.	1.064997E+06	454906.	62073.4	44637.8
1980	491126.	310008.	1.155725E+06	506468.	68468.2	47027.7
1981	528454.	337035.	1.252610E+06	562609.	75316.1	49409.6
1982	568292.	366022.	1.356151E+06	623741.	82649.9	51783.5
1983	610822.	397110.	1.466882E+06	690315.	90505.1	54149.6
1984	656244.	430451.	1.585378E+06	762821.	98919.7	56508.1
1985	704768.	466210.	1.712264E+06	841796.	107935.	58859.
1986	756621.	504562.	1.848205E+06	927822.	117593.	61202.7
1987	812046.	545694.	1.993926E+06	1.021535E+06	127943.	63589.2
1988	871304.	589808.	2.150300E+06	1.123627E+06	139033.	65868.7
1989	934673.	637120.	2.317867E+06	1.234856E+06	150919.	68191.2
1990	1.002453E+06	687863.	2.497826E+06	1.356043E+06	163657.	70507.

TABLE 3.4.2

THE FORECASTS OF IMPORTS BY ALL AIR CARRIERS BY CONTINENT

1975 - 1990

Shipping Weight (1000 pounds)

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa
1975	113991.	88641.2	433201.	226731.	5938.84	4233.91
1976	132077.	111477.	550487.	281680.	7431.49	5174.06
1977	144809.	127243.	599709.	319581.	8461.98	5823.12
1978	153217.	137299.	634311.	343757.	9119.29	6237.13
1979	167774.	155526.	689385.	387577.	10310.7	6987.53
1980	185478.	177943.	754870.	441469.	11776.	7910.44
1981	210359.	209893.	844276.	518279.	13864.3	9225.8
1982	214632.	214555.	864528.	529486.	14169.	9417.71
1983	220826.	221783.	891100.	546862.	14641.4	9715.29
1984	240010.	246243.	961064.	605666.	16240.2	10722.3
1985	260825.	272221.	1.084705E+06	668121.	17938.3	11791.8
1986	277816.	294476.	1.098773E+06	721623.	19393.	12708.1
1987	295914.	317553.	1.164764E+06	777103.	20901.4	13658.1
1988	314638.	341479.	1.232746E+06	834622.	22465.2	14643.1
1989	334021.	366295.	1.302829E+06	894282.	24087.3	15664.8
1990	354086.	392033.	1.375095E+06	956158.	25769.6	16724.4

TABLE 3.4.3

THE FORECASTS OF EXPORTS BY U.S. FLAG CARRIERS BY CONTINENT

1975 - 1990

Shipping Weight (1000 pounds)

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa
1975	133024.	63026.6	247616.	111579.	11686.7	9028.35
1976	142492.	68890.3	270377.	125175.	13211.9	9838.96
1977	152640.	75146.8	294580.	139943.	14848.8	10690.1
1978	163520.	81825.2	320345.	155992	16604.3	11583.8
1979	175183.	88956.6	347799.	173436.	18487.1	12522.2
1980	187685.	96574.6	377081.	192404.	20506.4	13507.5
1981	201088.	104715.	408337.	213032.	22672.1	14542.1
1982	215456.	113416.	441730.	235471.	24994.8	15628.4
1983	230858.	122719.	477429.	259885.	27486.	16769.
1984	247369.	132669.	515621.	286452.	30157.7	17966.7
1985	265069.	143813.	556506.	315368.	33023.1	19224.2
1986	284043.	154701.	600297.	346845.	36096.3	20544.6
1987	304384.	166888.	647228.	381113.	39392.2	21931.1
1988	326189	179933.	697547.	418425.	42927.2	23386.8
1989	349564.	193898.	751523.	459056.	46718.4	24915.4
1990	374622.	208851.	809447.	503306.	50784.5	26520.3

TABLE 3.4.4

THE FORECASTS OF IMPORTS BY U.S. FLAG CARRIERS BY CONTINENT

1975 - 1990

Shipping Weight (1000 pounds)

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa
1975	50816.4	35666.6	197872.	120251.	2717.77	726.617
1976	54556.	44874.4	226959.	143466.	3501.05	824.368
1977	59176.6	51231.2	247916.	159853.	4041.79	891.353
1978	63112.9	55286.	262299.	170735.	4386.72	984.899
1979	68283.6	62635.4	285949.	189444.	5011.9	1012.92
1980	74788.7	71674.3	314323.	212159.	5780.8	1108.38
1981	83677.8	84556.8	353520.	244017.	6876.67	1245.64
1982	88487.4	86436.4	361521.	249613.	7036.56	1265.59
1983	91975.1	89350.8	372397.	257655.	7284.48	1296.53
1984	98120.	99213.3	402885.	282244.	8123.44	1401.23
1985	105726.	109688.	435056.	308272.	9014.5	1512.44
1986	113278.	118662.	462926.	330698.	9777.84	1607.7
1987	120961.	127967.	491685.	353895.	10569.4	1706.48
1988	128862.	137614.	521864.	377887.	11890.	1808.9
1989	137026.	147620.	552012.	402716.	12241.2	1915.12
1990	145480.	157993.	583665.	428411.	13124.	2025.3

TABLE 3.4.5 THE PREDICTED GROWTH RATES OF EXPORTS AIR FREIGHT* TRAFFIC BY WORLD REGIONS (1975 - 1990)

All Air Carriers

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	Total %
1975-80	9.2	9.2	8.9	12.0	9.9	6.1	9.3
1980-85	8.5	8.5	8.2	10.7	10.7	4.6	8.6
1985-90	8.1	8.1	7.8	10.0	8.7	3.7	8.2
1975-90	8.6	8.6	8.3	10.9	9.8	4.8	8.7

*Growth of Export Tons

TABLE 3.4.6 THE PREDICTED GROWTH RATES OF IMPORTS* AIR TRAFFIC BY WORLD REGIONS (1975-1990)

All U.S. Flag Carriers

Year	North America	South America	Europe	Asia	Australia and Oceania	Africa	Total %
1975-80	7.1	8.9	8.8	11.5	11.9	8.4	9.0
1980-85	7.1	8.2	8.1	10.4	10.0	7.3	8.5
1985-90	7.2	7.8	7.8	9.8	9.0	6.6	8.2
1975-90	7.1	8.3	8.2	10.6	10.3	7.4	8.6

*Growth of Import Tons

IV CONVERSIONS BETWEEN TON-MILE AND TON FORECASTS

The revenue ton-mile is the common industry measure of air carrier production of freight transportation service. The enplaned ton is a more direct measure of freight activity at U.S. airports. Both measures are required for airways and airport facilities planning by federal, state and local agencies. Time series continuity and comprehensive coverage of available data, more than any other factor, dictated the unit of measure employed in the dependent variable in the forecasting model equations. Civil Aeronautics Board (CAB) Revenue Ton-miles(RTM) data proved best for domestic services. U.S. Department of Commerce Imports and Exports tonnage data proved best for total international air freight traffic in and out of U.S. airports.

Conversion of the domestic model outputs from revenue ton-miles to enplaned tons and the international export and import tons to revenue ton-miles has been accomplished by application of projected values of average haul distances. For domestic average haul, the reported ton-mile statistics* for the aggregate of all domestic freight and express services were divided by the enplaned tonnage statistics** for the same services for the years between 1962 and 1974. The increasing trend over this

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*Source: CAB Air Carrier Activity Statistics

**Source: CAB Airport Activity Statistics

period was extrapolated from the 1974 value at a rate of 15 miles per year. (See Figure 4.1)

The average haul distance for all exports and imports between the aggregate of all U.S. airports and each of the six world trading regions was estimated in an indirect manner. No set of ton-mile data parallel to the tonnage data is available. CAB reports enplaned tons at U.S. airports for U.S. flag carriers only and then provides no indication of the world region destination of those enplanements. The U.S. Department of Commerce does not report ton-mile statistics for air imports and exports. The dominance of foreign flag carriers in total U.S. international air freight traffic and the substantial differential growth rates in trade between the U. S. and the six world trading regions* prompted the estimating procedure which follows.

First, the major U.S. gateway hub for the flows to and from each country was subjectively determined by agreement between the FAA and TSC project managers. Then the statute miles between the respective U.S. gateway and the capital city of each country was obtained from the Reuben H. Donnelly Official Airline Guide--Worldwide Edition for May 1976. The "non-stop mileage" between these points was used unless none was listed, in which case the "Maximum Mileage" was used.

Next, a weighted average distance to each world region was

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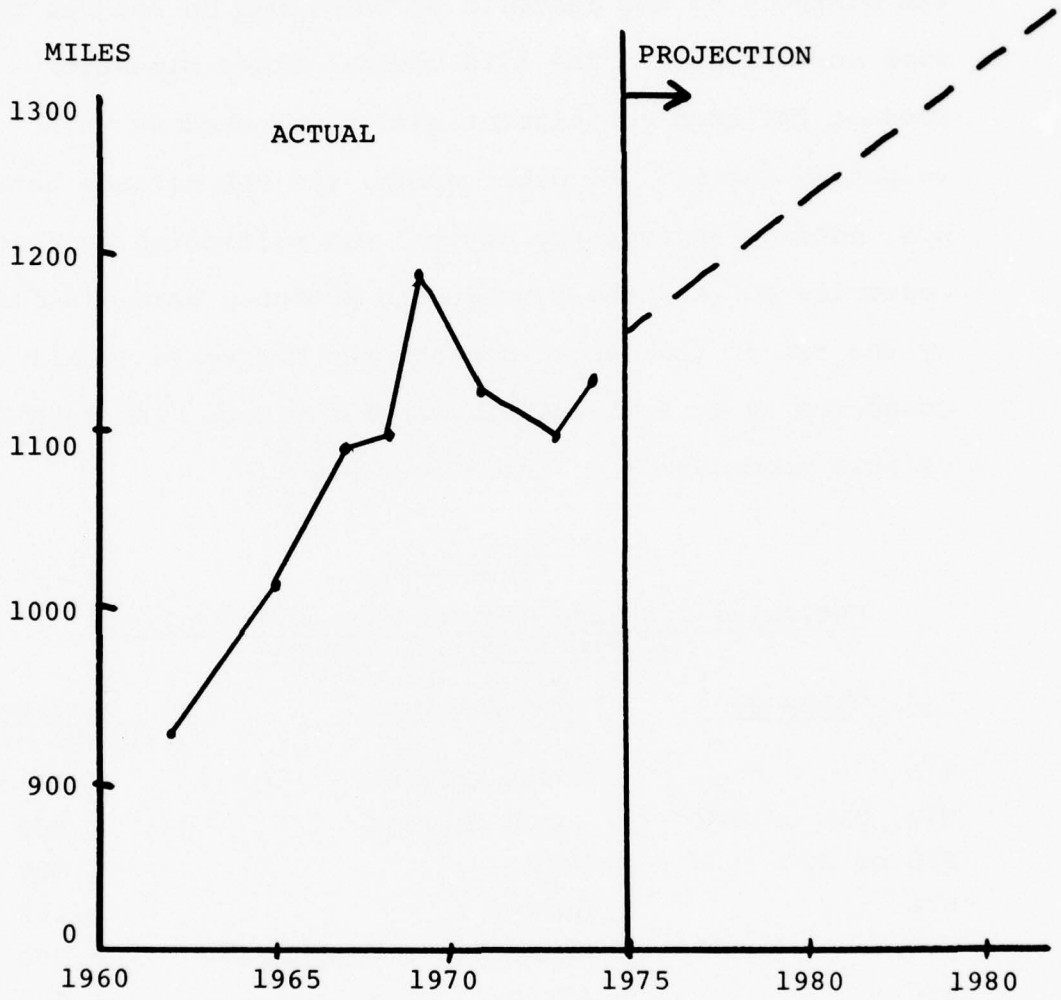
* See Appendix 1.2

FIGURE 4.1

PROJECTED AVERAGE HAUL DISTANCE DOMESTIC FREIGHT AND EXPRESS



Sources: CAB Air Carrier Traffic Statistics, CAB Airport Activity Statistics (see Table 2)

developed. No data exists to permit disaggregation of the U.S. air export and import tons to and from the world trading regions by the constituent countries. Therefore, a weighting factor other than tonnage was needed to estimate the distance to the centroid of the flows in and out of each world region. The 1973 Nominal Gross Domestic Product for each constituent nation was used as the weighting factor. In other words, the OAG mileage between U.S. gateway and country capital was multiplied by that countries GDP and the sum of such products were divided by the sum of the GDP values for the aggregate of all countries in each of the six world regions. The results of this procedure are listed in Table 4.1.

Table 4.1

Estimated Distance Between U.S. and Centroids of World Trading Regions

U.S. Gateways	World Region	Distance (Statute Miles)
MIA	South America	4,000
MIA, DAL or NYC	North America	600
SFO or NYC	Asia	6,300
NYC	Europe	4,100
SFO	Australia & Oceania	8,900
NYC	Africa	6,500

These surrogate average haul distances were used to convert the forecasted tons (of exports to and tons of imports from each of the world regions) into revenue ton-miles

for the U.S. flag carriers only, and also for the aggregate of all U.S. and foreign flag carriers. The foreign flag traffic is, therefore, obviously a residual calculation.

This procedure gives consideration to different rates of growth between revenue ton-miles of service produced by the carriers and tonnage activity at U.S. airports while also considering relative growth rates of the different U.S. trading partners. The trends in the imbalance between enplanements and deplanements at U.S. airports as well as trends in U.S. flag and foreign flag activity are explicitly treated by this procedure. Another unique feature of these revenue ton-mile forecasts is that they represent only traffic to and from U.S. airports and they are not clutered with extraneous activity between foreign points. In the past, this has been a deficiency of forecasts of U.S. flag carrier international service.

V RECOMMENDED BASE FORECAST OF AIR CARGO

This section compiles the base forecast for the period 1975 to 1990 using the models described in the previous sections and the input data listed in the appendixes of this paper. Although the model development part of this project was limited to forecasting the freight and express portion of the total air cargo flows, the FAA required a complete cargo forecast including mail flows. Therefore, the sponsor furnished, as an input, the results of an independent air mail demand forecasting effort.* The annual forecasts of enplaned cargo tons and of revenue ton-miles at various levels of aggregation, which are presented in Tables 5.1 through 5.7, include these mail forecasts. These tables present TSC's recommended current

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*Forecasts of domestic tons and ton-miles of mail demand were inputs to this project. They were based on U.S. Postal Service data which historically reflects lower values than does CAB data. This is in part because the Postal Service records pounds of mail shipped between origination and destination airports but does not concern itself with the number of intermediate interchanges. Since total enplanement activity at all U.S. airports including any activity for interchanges is the concern of this project, a correction factor was applied to the mail tons and ton-miles forecasts to develop the values presented in this section. The U.S. international mail ton-mile forecasts for civilian mail were received as direct inputs. The military portion was added by projecting a steady one percent per year growth rate over the 1975 value. The forecast of enplanement tons of international mail at U.S. airports was calculated by applying the projected average hauls for international freight described in the previous section.

basic forecast given the input assumptions and projections developed by concensus of the project analysts and the TSC and FAA project management. As has been indicated earlier in this paper, the models appear to adequately explain aggregate air freight demand in terms of the two variables of GNP and average revenue yield. The accuracy of the forecasts, which are the product of these models, is obviously dependent on the basic subjective judgements built into the future projections of the explanatory variables. Therefore, these forecasts are offered as base forecasts reflecting conservative judgements relative to the future trends of the national economy and air cargo service prices.

Table 5.1 displays forecasts of U.S. domestic demand for air cargo and its constituent elements of freight (including express) and mail. Enplaned tons at all U.S. airports by all scheduled and non-scheduled services as well as the ton-miles of revenue service are shown.

Table 5.2 shows forecasts of International air cargo tons being exported from U.S. airports. Freight (including express) and mail enplaned tons are forecasted for the aggregate of all scheduled and non-scheduled services. Enplaned freight tons have been forecasted separately for U.S. flag and foreign flag carriers. Mail has been forecasted, by others, in the aggregate for all carriers.

TABLE 5.1: U.S. DOMESTIC AIR CARGO TRAFFIC

ALL SERVICES (1)

Year	Revenue Cargo Enplaned Tons (thousands)			Revenue Cargo Ton-Miles (millions)		
	Total	Freight (2)	Mail (3)	Total	Freight	Mail (3)
71	2918	2054	864	3137	2442	709
72	3301	2448	853	3395	2712	689
73	3623	2718	905	3662	2976	686
74	3427	2600	827	3632	2940	692
75	3369	2592	777	3664	2981	683
76	3752	2800	952	4111	3262	849
77	3939	2976	963	4371	3512	859
78	4020	3060	960	4513	3657	856
79	4215	3243	972	4791	3924	867
80	4467	3481	986	5144	4264	880
81	4841	3848	993	5658	4772	886
82	4835	3861	974	5715	4846	869
83	4876	3909	967	5826	4964	862
84	5163	4185	978	6250	5378	872
85	5487	4489	998	6726	5836	890
86	5764	4745	1019	7149	6240	909
87	6057	5014	1043	7598	6668	930
88	6369	5301	1068	8083	7130	953
89	6699	5606	1093	8598	7623	975
1990	7051	5929	1122	9153	8152	1001

(1) Includes Scheduled and Non-Scheduled Services
(2) Includes Express
(3) Derived by TSC from "Forecasting Models for Domestic and International Air Mail" June 1976 by Washington Data Processing, Inc. for FAA,AVP-120

TABLE 5.2: U.S. INTERNATIONAL AIR CARGO TRAFFIC

ALL SERVICES FROM ALL U.S. AIRPORTS[1]

REVENUE CARGO ENPLANED TONS (thousands)[3]

Year	Freight[2]		Mail
	U.S. Flag Carriers	Foreign Flag Carriers	All Carriers
71	163	287	na
72	184	352	na
73	241	443	na
74	275	517	137
75	288	539	115
76	315	592	123
77	344	649	126
78	375	710	128
79	408	776	131
80	443	846	134
81	482	920	134
82	523	1001	135
83	568	1087	139
84	615	1180	141
85	666	1280	144
86	721	1387	147
87	780	1502	150
88	844	1626	153
89	913	1759	156
1990	987	1902	160

(1) Includes Scheduled and Non-Scheduled Service of all U.S. Flag and Foreign Flag Carriers
(2) Includes Express
(3) Exports only

Table 5.3 lists forecasts of imported tons of international traffic deplaned at U.S. airports. Deplaned freight tons are segregated by U.S. flag and foreign flag carriers. No inbound mail in international service was forecasted by the FAA mail forecasting project.

Table 5.4 displays U.S. International air cargo exports in terms of ton-miles of transport service provided. Ton-miles generated by freight (including express) and mail enplaned at U.S. airports only are represented.

Table 5.5 displays U.S. International air freight (including express) imports in terms of ton-miles. U.S. flag carrier and foreign flag carrier traffic is segregated. Here again no mail imports have been forecasted.

Table 5.6 provides aggregations of all forecasted services in both tons of *enplaned cargo* (including freight, express and mail) and ton-miles of cargo generated by all scheduled and non-scheduled services to and from all U. S. airports.

Table 5.7 tabulates the average annual growth rates which are implied by the forecasts presented in Table 5.1 to 5.6. The relative growth rates of the various services (i.e., freight, mail, U.S. domestic, U.S. international, foreign flag and U.S. flag) are shown for the entire 15 year forecast period and for each of the three 5 year subperiods between 1975 and 1990. Differences in growth rates between the five year periods are due solely to the

TABLE 5.3: U.S. INTERNATIONAL AIR CARGO TRAFFIC

ALL SERVICES TO ALL U.S. AIRPORTS (1)

REVENUE CARGO DEPLANED TONS (thousands) (3)

	Freight (2)		Mail
Year	U.S. Flag Carriers	Foreign Flag Carriers	All Carriers
71	188	224	
72	208	257	
73	222	278	
74	218	310	
75	204	257	
76	237	307	
77	262	341	
78	278	364	
79	306	403	
80	339	451	No Forecast
81	387	516	
82	397	526	
83	410	542	
84	446	594	
85	485	648	
86	518	694	
87	553	742	
88	589	791	
89	627	842	
1990	665	894	

(1) Includes Scheduled and Non-Scheduled services of all U.S. and Foreign Flag Carriers
(2) Includes Express
(3) Imports Only

TABLE 5.4: U.S. INTERNATIONAL AIR CARGO TRAFFIC

ALL SERVICES OUT OF ALL U.S. AIRPORTS(1)

REVENUE CARGO TON-MILES *EXPORTS* (millions)

	Freight(2)		Mail
Year	U.S. Flag Carriers	Foreign Flag Carriers	All Carriers
71	582	1068	na
72	666	1325	na
73	910	1741	na
74	1055	2035	536
75	1106	2141	455
76	1220	2363	488
77	1342	2601	500
78	1472	2857	512
79	1613	3130	527
80	1764	3426	539
81	1926	3742	540
82	2101	4083	550
83	2289	4449	566
84	2491	4843	578
85	2710	5267	590
86	2945	5724	603
87	3199	6217	617
88	3473	6748	632
89	3768	7321	647
1990	4087	7939	666

(1) Includes Scheduled and Non-Scheduled Services of all U.S. Flag and Foreign Flag Carriers

(2) Includes Express

TABLE 5.5: U.S. INTERNATIONAL AIR CARGO TRAFFIC

ALL SERVICES IN TO ALL U.S. AIRPORTS[1]

REVENUE CARGO TON-MILES IMPORTS

Year	Freight[2]		Mail
	U.S. Flag Carriers	Foreign Flag Carriers	All Carriers
71	705	1069	
72	792	1226	
73	826	1315	
74	805	1416	
75	885	1071	
76	1042	1287	
77	1153	1438	
78	1228	1537	No Forecast
79	1354	1710	
80	1508	1920	
81	1722	2216	
82	1762	2265	
83	1818	2338	
84	1984	2566	
85	2149	2817	
86	2313	3013	
87	2468	3229	
88	2630	3452	
89	2797	3681	
1990	2971	3920	

(1) Includes Scheduled and Non-Scheduled Services of All U.S. Flag and Foreign Flag Carriers
(2) Includes Express

TABLE 5.6: U.S. AIR CARGO TRAFFIC[1]

ALL SERVICES IN AND OUT OF ALL U.S. AIRPORTS [2]

Year	Revenue Cargo Enplaned Tons[3] (thousands)			Revenue Cargo Ton-Miles[4] (millions)		
	Total	U.S. Domestic	U.S. International	Total	U.S. Domestic	U.S. International
71		2918			3137	
72		3301			3395	
73		3623			3662	
74	4356	3427	929	9479	3632	5847
75	4311	3369	942	9322	3664	5658
76	4782	3752	1030	10511	4111	6400
77	5058	3939	1119	11405	4371	7034
78	5233	4020	1213	12119	4513	7606
79	5530	4215	1315	13125	4791	8334
80	5890	4467	1423	14301	5144	9157
81	6377	4841	1536	15804	5658	10146
82	6494	4835	1659	16476	5715	10761
83	6670	4876	1794	17286	5826	11460
84	7099	5163	1936	18712	6250	12462
85	7577	5487	2090	20259	6726	13533
86	8019	5764	2255	21747	7149	14598
87	8489	6057	2432	23328	7598	15730
88	8992	6369	2623	25018	8083	16935
89	9527	6699	2828	26812	8598	18214
1990	10100	7051	3049	28736	9153	19583

(1) Includes Freight Express and Mail
(2) Includes scheduled and Non-scheduled service of all U.S. and Foreign Flag Carriers
(3) Exports only
(4) Includes Imports plus Exports

TABLE 5.7: AVERAGE ANNUAL AIR CARGO GROWTH RATES

ALL SERVICES

U.S. DOMESTIC TRAFFIC

	Revenue Cargo Enplaned Tons			Revenue Cargo Ton-Miles		
	Total Cargo	Freight[1]	Mail	Total Cargo	Freight	Mail
1975 - '80	5.8	6.2	4.9	7.2	7.4	5.2
'80 - '85	4.2	5.2	0.2	5.5	6.5	0.2
'85 - '90	5.1	5.7	2.4	6.3	6.9	2.4
'75 - '90	5.0	5.6	2.5	6.3	6.9	2.6

U.S. INTERNATIONAL TRAFFIC

	Export Cargo Enplaned Tons				Export & Import Cargo Ton-Miles			
	Total Cargo	Freight		Mail	Total Cargo	Freight		Mail
	All Carriers	U.S. Carriers	Foreign Carriers	All Carriers	All Carriers	U.S. Carriers	Foreign Carriers	All Carriers
1975 - '80	8.6	9.0	9.4	3.1	10.1	10.4	10.7	3.4
'80 - '85	8.0	8.5	8.6	1.4	8.1	8.2	8.6	1.8
'85 - '90	7.8	8.2	8.2	2.1	7.7	7.7	8.0	2.4
'75 - '90	8.1	8.6	8.8	2.2	8.6	8.8	9.1	2.6

(1) Includes Express

GNP projections since the revenue yield or the yield trend is held constant in these base forecasts. The greatest rate of growth is forecast for the period 1975-1980 for both the domestic and international service.

Revenue ton-miles reflect higher growth rates than does the enplaned tonnage at U.S. airports for both domestic and international services. International services reflect an overall RTM growth rate of 8.6 percent for the sum of all carriers while the domestic service shows a slightly lower growth rate of 6.3 percent. Mail reflects a considerably lower growth rate and tends to lower the cargo growth rates below that of freight (including express).

APPENDIX

1.1 The Forecast and Historical Input Data Series Used In Domestic Air Freight Forecast.

1. Historical and Forecast Real Yield per Ton-Miles (Case 1)
U.S. Domestic

1948*	30.5391	28.5642	26.3224	26.156
1952	26.4151	27.0576	27.3346	26.5243
1956	24.4707	23.4896	24.2	24.0016
1960	24.1069	22.8446	21.8378	21.9278
1964	20.7625	19.6644	18.8696	17.7736
1968	17.0891	16.9267	16.5631	16.3424
1972	15.8774	15.3587	15.4018	15.7098
1976	16.024	16.3445	16.6714	17.0048
1980	17.3449	17.6918	18.0457	18.4066
1984	18.7747	19.1502	19.5332	19.9239
1988	20.3224	20.7288	21.1434	21.5663

Sources: See Section 2.3

2. Historical and Forecast Real Yield per Ton-Miles (Case 3)
U.S. Domestic

1948	30.5391	28.5642	26.3224	26.156
1952	26.4151	27.0576	27.3346	26.5243
1956	24.4707	23.4896	24.2	24.0016
1960	24.1069	22.8446	21.8378	21.9278
1964	20.7625	19.6644	18.8696	17.7736
1968	17.0891	16.9267	16.5631	16.3424
1972	15.8774	15.3587	15.4018	15.0938
1976	14.7919	14.496	14.2061	13.922
1980	13.6436	13.3707	13.1033	12.8412
1984	12.5844	12.3327	12.086	11.8443
1988	11.6074	11.3753	11.1478	10.9248

Sources: See Section 2.3

*Each line covers four successive years i.e., first line 1948, 1949, 1950, 1951

3. Historical and Forecast Real Yield Per Ton-Miles (Case 2)
U.S. Domestic

1948*	30.5391	28.5642	26.3224	26.156
1952	26.4151	27.0576	27.3346	26.5243
1956	24.4707	23.4896	24.2	24.0016
1960	24.1969	22.8446	21.8378	21.9278
1964	20.7625	19.6644	18.3696	17.7736
1968	17.0891	16.9267	16.5631	16.3424
1972	15.8774	15.3587	15.4018	15.4018
1976	15.4018	15.4018	15.4018	15.4018
1980	15.4018	15.4018	15.4018	15.4018
1984	15.4018	15.4018	15.4018	15.4018
1988	15.4018	15.4018	15.4018	15.4018

Sources: See Section 2.3

4. Historical and Forecast of U.S. GNP (Billions 1958 constant dollars)

1949	324.1	355.3	383.4	395.1
1953	412.8	407.	438.	446.1
1957	452.5	447.3	475.9	487.7
1961	497.2	529.8	551.	581.1
1965	617.8	658.1	675.2	706.6
1969	725.6	722.5	746.3	792.5
1973	839.2	821.2	797.8	841.4
1977	871.5	890.7	925.5	968.3
1981	1029.3	1038.2	1052.	1098.7
1985	1148.3	1190.79	1234.85	1280.53
1989	1327.91	1377.05		

Sources: See Section 2.3

5. Historical Domestic Air Freight Traffic in Revenue Ton-Miles (millions)

1948	109.041	139.458	226.175	243.502
1952	249.047	263.347	253.659	338.653
1956	397.356	507.08	505.5	588.109
1960	611.706	715.469	988.185	924.517
1964	1102.72	1441.65	1690.58	1902.3
1968	2022.74	2491.31	2295.34	2441.62
1972	2713.86	2975.72	2940.16	

Sources: See Section 2.3

*Each line covers four successive years i.e., first line 1948, 1949, 1950, 1951

1.2 The Forecast and Historical Input Data Series Used in International Air Freight Forecast

1. Imports by All Air Carriers by Continent: 1965-1974 (shipping weight (1000 pounds)

NORTH AMERICA				
1964*	30993.	33117.	38818.	49810.
1968	70540.	90333.	85162.	93486.
1972	101700.	116898.	142313.	
SOUTH AMERICA				
1964	14392.	19321.	15386.	19249.
1968	21294.	29451.	43307.	68301.
1972	82305.	106653.	128150.	
EUROPE				
1964	68374.	111502.	134317.	178456.
1968	253878.	377063.	353686.	440234.
1972	488065.	513594.	509087.	
ASIA				
1964	13785.	26715.	39154.	54508.
1968	80180.	111353.	131233.	214567.
1972	247268.	253826.	261581.	
AUSTRALIA AND OCEANIA				
1964	270.	372.	701.	1339.
1968	2321.	3284.	3364.	4900.-
1972	6207.	6316.	7544.	
AFRICA				
1964	653.	764.	1198.	1449.
1968	1836.	2285.	2589.	2851.
1972	5040.	3807.	6008.	

Sources: See Section 3.2

*Each line covers four successive years i.e., first line 1964, 1965, 1966, 1967

2. Imports by U.S. Flag Carriers by Continent: 1965-1974
(Shipping Weight (1000 pounds)

NORTH AMERICA				
1964*	13428..	15734.	18001.	19658.
1968	34992.	39872.	39007.	38907.
1972	40481.	49888.	52075.	
SOUTH AMERICA				
1964	3919.	6436.	5637.	7249.
1968	9094.	11529.	18437.	39467.
1972	36567.	44229.	44385.	
EUROPE				
1964	32113.	55625.	61102.	65789.
1968	101857.	157998.	148483.	180640.
1972	194229.	211250.	215688.	
ASIA				
1964	9366.	17592.	25782.	32695.
1968	51562.	66947.	80688.	122995.
1972	139434.	133660.	115913.	
AUSTRALIA AND OCEANIA				
1964	44.	72.	341.	251.
1968	761.	768.	922.	1809.
1972	3701.	3028.	3435.	
AFRICA				
1964	273.	264.	417.	312.
1968	517.	592.	703.	693.
1972	1911.	764.	1404.	

Sources: See Section 3.2

*Each line covers four successive years i.e., first line 1964, 1965, 1966, 1967

3. Exports by U.S. Flag Carriers by Continent: 1965-1974
(Shipping Weight (1000 pounds)

NORTH AMERICA				
1965*	56431.	64703.	70856.	89792.
1969	106006.	91947.	92318.	99166.
1973	116852.	122197.		
SOUTH AMERICA				
1965	19211.	19484.	20220.	27858.
1969	34256.	33004.	33317.	38913.
1973	48873.	67475.		
EUROPE				
1965	63804.	66660.	78166.	101580.
1969	149691.	145749.	134784.	152723.
1973	210555.	243202.		
ASIA				
1965	15119.	17158.	22030.	25300.
1969	36102.	44351.	55360.	67649.
1973	90979.	95139.		
AUSTRALIA AND OCEANIA				
1965	1124.	1369.	2095.	3658.
1969	3041.	2936.	4986.	4730.
1973	8353.	11884.		
AFRICA				
1965	2936.	2850.	2350.	3882.
1969	5015.	3801.	4725.	3599.
1973	6739.	9952.		

Sources: See Section 3.2

*Each line covers four successive years i.e., first line 1965, 1966, 1967, 1968

4. Exports by All Air Carriers by Continent: 1965-1974
(Shipping Weight (1000 pounds)

NORTH AMERICA				
1965*	127312.	135267.	152330.	183814.
1969	213915.	224517.	227076.	253095.
1973	286102.	322486.		
SOUTH AMERICA				
1965	71346.	71190.	71258.	77918.
1969	100742.	95536.	101822.	127195.
1973		[illegible]		
EUROPE				
1965	182039.	206394.	249760.	303167.
1969	422115.	428942.	406230.	495928.
1973	647803.	719089.		
ASIA				
1965	29133.	37051.	51586.	61248.
1969	88162.	107485.	124636.	156285.
1973	226480.	252032.		
AUSTRALIA AND OCEANIA				
1965	5025.	5792.	8558.	13064.
1969	14496.	15987.	18381.	19155.
1973	30179.	40115.		
AFRICA				
1965	7411.	8049.	10365.	14621.
1969	20969.	18864.	21984.	20571.
1973	27294.	37989.		

Sources: See Section 3.2

*Each line covers four successive years i.e., first line 1965, 1966, 1967, 1968

5. Real Gross National Domestic Product by Continents: 1955-1990[1]
(million of 1958 U.S. dollars),

NORTH AMERICA

1965*	70198.4	75628.4	79376.6	83189.6
1969	91265.2	95069.4	104131.	113315.
1973	123861.	132779.	142339.	152587.
1977	163573.	175351.	187976.	201510.
1981	216018.	231572.	248245.	266118.
1985	285278.	305818.	327837.	351441.
1989	376745.	403870.		

SOUTH AMERICA

1965	60193.9	64280.3	61038.4	63080.9
1969	67270.6	74571.8	84108.9	94558.6
1973	105376.	113016.	121209.	129997.
1977	139422.	149530.	160371.	171998.
1981	184468.	197842.	212185.	227569.
1985	244068.	261762.	280740.	301094.
1989	322923.	346335.		

EUROPE

1965	453273.	473491.	490588.	497473.
1969	527709.	560847.	611415.	702174.
1973	825777.	890022.	959265.	1.033896E+ -
1977	1.114332E+06	1.201026E+06	1.294465E+06	1.395174E+06
1981	1.503718E+06	1.620706E+06	1.746796E+06	1.882696E+06
1985	2.029169E+06	2.187037E+06	2.357188E+06	2.540576E+06
1989	2.738232E+06	2.951265E+06		

Sources: See Section 3.2

*Each line covers four successive years i.e., first line 1965, 1966, 1967, 1968

5. Real Gross National Domestic Product by Continents: 1955-1990[1]
(million of 1958 U.S. dollars)
(Continued)

ASIA

1965[2]	193681.	204897.	216694.	237537.
1969	262718.	277000.	295259.	351047.
1973	428853.	467449.	509520.	555377.
1977	605361.	659843.	719229.	783960.
1981	854516.	931423.	1.015251E+06	1.106623E+06
1985	1.206219E+06	1.314778E+06	1.433108E+06	1.562087E+06
1989	1.702675E+06	1.855916E+06		

AUSTRALIA AND OCEANIA

1965	25442.	26808.	27339.	28365.5
1969	30115.4	31624.5	34330.4	39145.9
1973	44547.3	47777.	51240.9	54955.8
1977	58940.2	63213.3	67796.2	72711.4
1981	77983.	83636.7	89700.4	96203.6
1985	103178.	110659.	118682.	127286.
1989	136514.	146412.		

AFRICA

1965	44224.2	42257.3	44428.9	46035.2
1969	46517.1	49412.1	52244.1	55991.
1973	64016.6	67217.4	70578.2	74107.1
1977	77812.4	81703.1	85788.2	90077.6
1981	94581.4	99310.5	104276.	109490.
1985	114964.	120712.	126748.	133085.
1989	139740.	146727.		

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[1] The data from 1955 to 1974 are actual. The data from 1975 to 1990 are extrapolated based on their respective past growth rates from 1956 to 1974.

[2] Each line covers four successive years i.e., first line 1965, 1966, 1967, 1968

6. Real Average Yield Per Ton-miles (cents, international and territorial operations)

1965*	19.8358	18.1762	17.4419	16.3777
1969	15.5148	15.4614	15.451	14.8782
1973	14.0237	14.7316	14.437	14.1483
1977	13.8653	13.588	13.3162	13.0499
1981	12.7889	12.5331	12.2825	12.0368
1985	11.7961	11.5602	11.329	11.1024
1989	10.8803	10.6627		

Sources: See Section 3.2

*Each line covers four successive years i.e., first line 1965, 1966, 1967, 1968

1.3 World Regions and Constituent Countries

The world has been classified into six regions: (1) North American, (2) South American, (3) Europe, (4) Asia, (5) Oceania and Australia, and (6) Africa which are based on the Department of Commerce "Guide to Foreign Trade Statistics".

The United Nations "Statistical Yearbook" also classifies these countries by regions and GDP data are available as follows:

I. North America: (Countries whose GDP falls under $300 million U.S. dollars are not included.

1. Canada
2. Costa Rica
3. Dominican Republic
4. El Salvador
5. Guatemala
6. Haiti
7. Honduras
8. Jamaica
9. Nicaragua
10. Trinidad and Tobago
11. Mexico
12. Panama

II. South America (GDP under $200 million U.S. dollars are not included)

1. Argentina
2. Bolivia
3. Brazil
4. Colombia
5. Chille
6. Ecuador
7. Paraguay
8. Peru
9. Venezuela
10. French Guiana
11. Guyana

III. Europe: (GDP under $300 million U.S. dollars are not included)

1. Belguim
2. France
3. West Germany
4. Italy
5. Luxembourg
6. Netherlands
7. Austria
8. Denmark
9. Norway
10. Portugal
11. Sweden
12. Switzerland
13. United Kingdom
14. Finland
15. Greece
16. Iceland
17. Ireland
18. Spain

IV. Asia: (GNP under $300 million U.S. dollars are not included)

1. Ceylon (Sri Lanka)
2. China (Taiwan)
3. Hong Kong
4. India
5. Iran
6. Japan
7. Korea
8. Malaysia
9. Nepal
10. Pakistan
11. Philippines
12. Singapore
13. Thailand
14. Viet-Nam
15. Isreal
16. Kuwait
17. Iraq
18. Burma
19. Indonesia
20. Jordan
21. Syria Arab Republic
22. Turkey
23. Lebanon
24. Saudi Arabia
25. Cyprus

V. Australia and Oceania

1. Australia
2. New Zealand

VI Africa: (GDP under $300 million U.S. dollars are not included)

1. Algeria
2. Cameroon
3. Ethiopia
4. Ghana
5. Ivory Coast
6. Kenya
7. Libya
8. Madagascar
9. Morocco
10. Nigeria
11. Senegal
12. South Africa
13. Southern Rhodesia
14. Sudan
15. Tanzania, Un. Rep.
16. Tunisia
17. Uganda
18. United Arab Republic
19. Zambia

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